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Low Mileage Catalyst Evaluation with a Methanol-Fueled Rabbit - Interim Report

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16. ABSTRACT

This report summarizes a test program which was designed to evaluate various exhaust catalysts at low mileage on a pure methanol-fueled Volkswagen Rabbit automobile. Hydrocarbons, carbon monoxide, nitrogen oxides and formaldehyde emissions were measured to identify which catalysts are the best candidates for durability testing in a later program. Catalysts formulations that are eventually selected for durability testing should cost no more, and preferably less, than the original catalyst on the vehicle. In addition, all catalysts should provide the capability to meet the Federal Exhaust Emission Standards for hydrocarbon (HC), carbon monoxide (CO) and nitrogen oxide (NOx).

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Technical Report

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by

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May, 1983

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Background

The use of pure methanol as an automotive fuel could allow the use of less expensive exhaust catalysts. Two important benefits are expected from the use of methanol compared to unleaded gasoline. The benefits are reduced levels of catalyst poisons, such as lead and sulfur, and reduced exhaust gas temperatures at the catalyst inlet. Both major mechanisms of catalyst deactivation, poisoning and thermal degradation, could be less severe.

The purpose of this program is to evaluate various exhaust catalysts at low mileage on a pure methanol-fueled Volkswagen Rabbit. HC, CO, NOx and formaldehyde emissions will be measured to identify which catalysts are the best candidates for durability testing in a later program. Catalyst formulations that are eventually selected for durability testing should cost no more, and preferably less, than the original catalyst on the vehicle.

All candidate catalysts should provide the capability to meet the 0.41 HC and 3.4 CO levels at low mileage with substantial margins of safety. Additionally, 3-way catalysts should provide emissions well below the 1.0 NOx level.

Conclusions

1. Several catalysts have been identified as good candidates for vehicle durability testing. All of these catalysts contain noble metals. The catalysts recommended for durability are 1) platinum and rhodium in a ratio of 5:1 at a loading of 40 grams/cubic foot (a loading identical to the original catalyst on the vehicle and identical to that used on the forty vehicles provided to the California Energy Commission), 2) platinum and palladium in a ratio of 3:2 at 20 grams/cubic foot, and 3) all palladium at a loading of 40 grams/cubic foot. All catalyst volumes would be 75 cubic inches. All catalyst substrates would be 400 cells per square inch with a wall thickness of 6 mils.

2. One catalyst was tested which was all base metal. It was pure copper mesh. The copper mesh provided some HC conversion over the highway cycle, but not much else. CO control over the FTP was poor with the catalyst, and it provided little NOx control with stoichiometric exhaust conditions.

3. One catalyst has been tested which includes substantial amounts of both base and noble metals. The inclusion of the base metals provided no significant emissions benefit in comparison to other palladium catalysts in this study.

Future Effort

The results which have been obtained so far will be provided to the vehicle and catalyst manufacturers who have assisted us in this program. We will request their advice on the following subjects.

- o how to improve the emissions control capability of previously tested and poorly performing catalysts,
- o which additional catalysts should be tested at low mileage,
- o how to further reduce the cost of durability-candidate catalysts, and
- o how to improve the durability emissions performance of those catalysts which performed well in our low mileage testing.

We now plan to further evaluate the copper mesh after an acid dip and with the addition of insulation to the exhaust system. The silver catalyst will be further evaluated with exhaust system insulation and possibly with some varying thermal pretreatments. A copper oxide catalyst will also be tested.

Based on our testing to date, it appears as though we may need to retain rhodium for achieving the lowest possible aldehyde levels. New catalyst candidates could include more lightly loaded platinum/rhodium catalysts in the 10-20 gram/cubic foot range and palladium/rhodium units in the same loading range and with Pd: Rh ratios of 5:1 or 10:1.

Test Vehicle Description

The test vehicle is a 1981 model year Volkswagen Rabbit. It was modified by Volkswagen to operate on methanol plus 5.5% isopentane. It is a 4-door sedan equipped with air conditioning, a 3-speed automatic transmission, and a 1.6 liter engine. The compression ratio of the engine is 12.5:1. Maximum power output is 88 horsepower at 5600 RPM (1)*. The tire size is 155 SR 13. The tires are Michelin XZX radials. It was tested at 2250 pounds inertia weight and 7.3 actual dynamometer horsepower.

The emission control system, as equipped by Volkswagen includes feedback controlled, continuous fuel injection (K-Jetronic) and a three-way catalyst. The catalyst provided by VW was 4.0 inches in diameter and 6.0 inches long. It contained platinum (Pt) and rhodium (Rh) in a ratio of 5:1 at a loading of 40 g/ft^3. The vehicle is described in more detail in Appendix 1, which was taken from a Volkswagen emission control status report (2) to EPA.

The emission control system was modified by EPA to include a pump-type air injection system. The air was injected into the exhaust at a location about a foot downstream from the oxygen sensor. A manually adjustable valve was installed in the line between the diverter valve and the exhaust inlet. This valve allowed us to vary oxygen concentration into the catalyst while operating the engine in the closed loop mode.

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*Numbers in parenthesis are references listed at the end of this report.

Test Sequence, Instrumentation, and Fuel

The initial plan included testing of the vehicle and each catalyst over the following sequence:

1975 Federal Test Procedure
Highway Test Procedure
20 mph steady state
30 mph steady state
40 mph steady state.

The sequence would be repeated twice for each catalyst at each of three exhaust oxygen levels. The higher two of the three exhaust oxygen levels were measured at the catalyst inlet using a Sun oxygen analyzer and were obtained at 30 miles per hour steady state. The three oxygen levels were stoichiometry (or near 0%), 3%, and 5%. By testing at different exhaust oxygen levels, we could evaluate each catalyst as a 3-way and also as an oxidizing catalyst.

As the project proceeded, idle and a 10 mph steady state were added to the sequence and the 40 mph steady state was deleted. HC, CO, NOx, MPG, methanol, methane, and aldehydes were initially measured over each test in the sequence. Aldehydes were deleted during steady states in more recent testing. Methanol was deleted for all testing as the program progressed.

Exhaust HC emissions, as reported here, were measured with a flame ionization detector (FID) from Beckman (model 400). No corrections in the results were made for either the FID response to methanol or the difference in HC composition with methanol as the fuel. NOx emissions were measured with a chemiluminescent NO/NOx analyzer from Beckman (model 951A). CO was measured with infrared analyzers from MSA and Bendix. Methane was measured with a gas chromatograph (Bendix 8205 methane analyzer). Aldehydes were measured by high pressure liquid chromatography (HPLC). See Appendix 2 for more details. Gaseous methanol was measured by a gas chromatograph (Perkins-Elmer model 3920).

The test fuel which has been used is pure methanol. Three batches of the fuel have been used, and one has been analyzed. The fuel analysis is presented in Appendix 3.

FTP Test Results

The Rabbit has been tested with a total of nine different catalysts. Those catalysts are described in Table 1. Also, the vehicle has been periodically tested with no catalyst to assure that major changes in emissions without a catalyst have not occurred over the duration of the test program. The vehicle emissions with no catalyst as a function vehicle odometer reading are shown in Figures 1 and 2. There was an oxygen sensor change to the emission control system which may have resulted in a slight shift in FTP emissions at about 6,300 miles; however, HC, CO, NOx, and methanol emissions have been reasonably stable over the test program to date.

Aldehyde emissions were not as stable as desired. The cause of variablity in the aldehyde emissions is being investigated. We know the column was changed in the liquid chromatograph (to a nominally identical column) just prior to generating the value of about 130 mg/mi in Figure 2. The impact of the column change on the variability is unknown. It is possible that the aldehyde emissions are of such a small magnitude that we may not be able to get rid of the variability with this particular vehicle and test equipment.

Table 1

Catalysts Tested to Date

Abbreviated Catalyst Code	CPSI and t_{wall} [$1/in^2$] [mils]	Substrate Size [Diameter and Length]	Substrate Volume [in^3]	----Noble Metals---- Ratio	----Noble Metals---- Load [g/ft^3]	Major Base Metals
5 Pt: Rh(40)	300,10.5	4.0" x 6.0"L	75	5Pt:1Rh	40	
12 Pt: Rh(40)	400,6	4.0" x 6.0"L	75	12Pt:1Rh	40	
12 Pt: Rh(40)*	400,6	3.18" x 6.68" x 6.0"L	110	12Pt:1Rh	40	
3 Pt: 2 Pd(20)	400,6	4.0" x 6.0"L	75	3Pt:2Pd	20	
Pd (40)	400,6	4.0" x 6.0"L	75	Pd	40	
Pd + BM (35)	400,6	4.0" x 6.0"L	75	Pd	35	Proprietary transition elements
Cu	N/A	4.25" x 12.0"L	170	None		Copper mesh 7.7% packing density
Pd (20)	400,6	4.0" x 6.0"L	75	Pd	20	
Ag (150)	400,6	4.0" x 6.0"L	75	Ag	150	

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*This catalyst is a "racetrack" in cross section. All other catalysts are circular in cross section.

FIGURE 1
EMISSIONS WITHOUT CATALYST
0% O 2

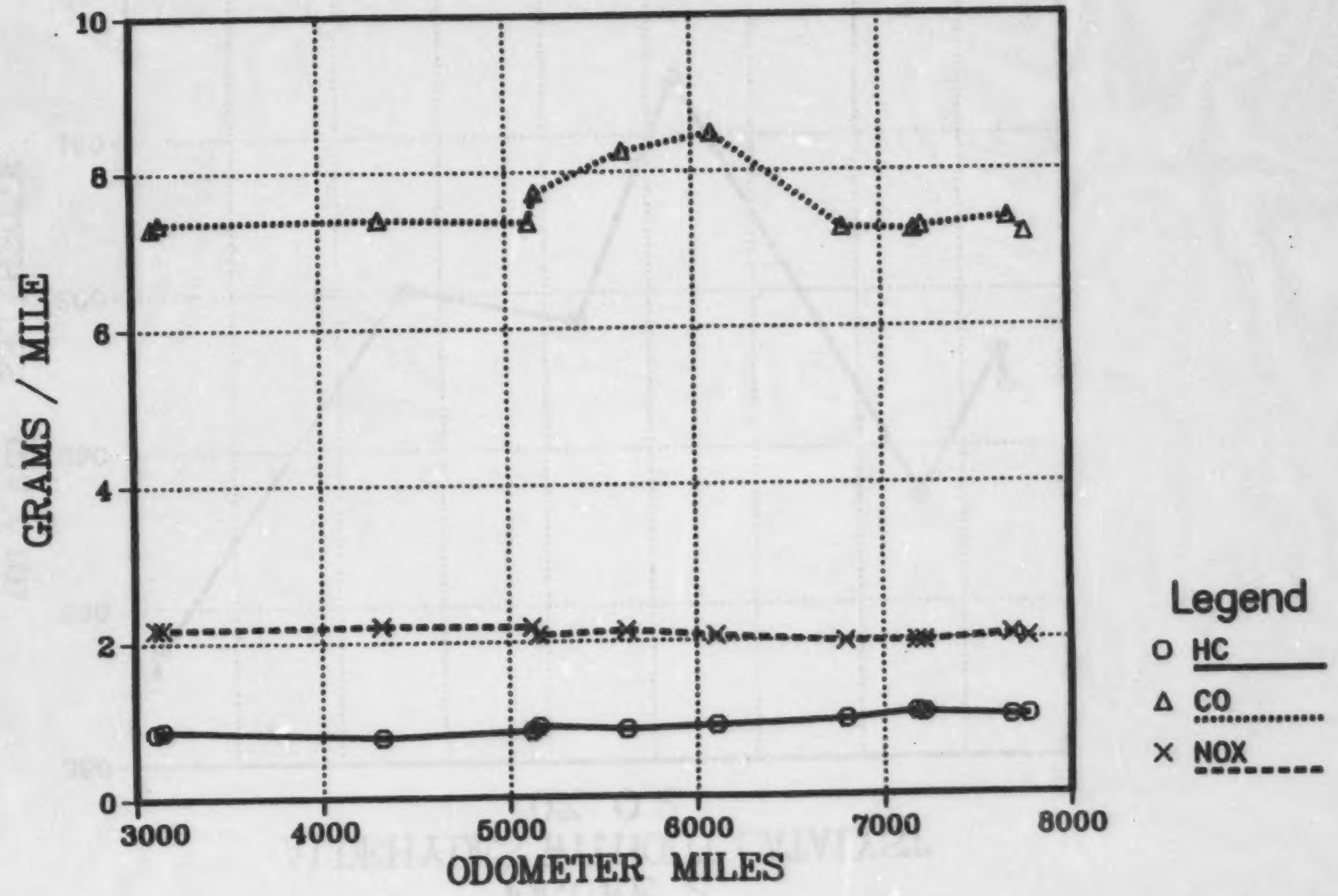
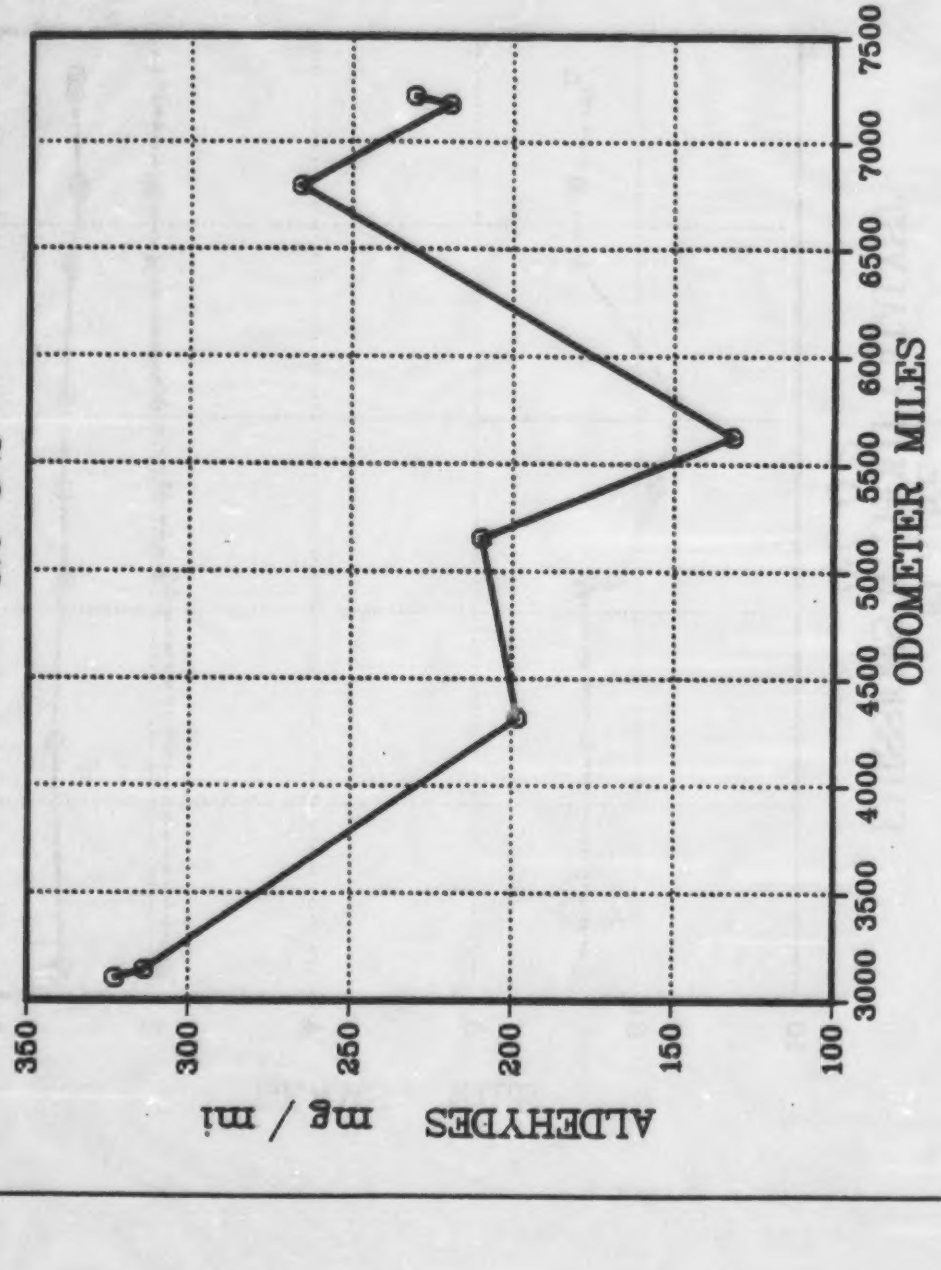


FIGURE 2
ALDEHYDES WITHOUT CATALYST
0% O2



In Table 1, the catalysts have been referred to by an an Abbreviated Catalyst Code. The original catalyst on the vehicle contained platinum and rhodium in 5:1 ratio at a loading of 40 grams per cubic foot of substrate volume. As an example of the Abbreviated Catalyst Code, this catalyst has been referred to as catalyst 5 Pt: Rh (40).

All catalysts in the group are of identical volume except for the 12 Pt:Rh (40)* catalyst and the Cu catalyst. The 12 Pt: Rh (40)* catalyst is a sample of 110 in^3. Initially we planned to test all samples in two volumes; however, the smaller noble metal samples were so active that increased catalyst volume would likely be able to provide little improvement in low mileage conversion efficiency. If durability testing is unsuccessful, then larger catalyst volumes may be one of several possible paths to take.

All catalysts used in the program were zero mile catalysts except for the original catalyst on the vehicle. Assuming this catalyst had been on the vehicle since manufacture, it had accumulated less than 3,000 miles prior to testing at EPA.

Tailpipe emissions from this vehicle with no catalyst at stoichiometric operating conditions averaged 0.92 HC, 7.52 CO, 2.08 NOx. In comparison to gasoline-fueled vehicles, these simultaneous CO and NOx levels are low for an engine operating at stoichiometry with no EGR.

Tables 2, 3, and 4 present summaries of the FTP results which were obtained at each exhaust oxygen level. Non-methane HC results are nearly identical to total HC results at all three oxygen levels with and without catalysts. This indicates that there is virtually no methane in the exhaust. Average HC and CO emssions are below levels of 0.2 HC, 2.0 CO for all except the silver (Ag), copper (Cu), and mixed metal (Pd + BM) catalysts at all oxygen levels.

Individual emission test results are presented in Appendix 4. Additional statistics, including standard deviations that correspond to the the mean values in Tables 2, 3, and 4 are shown in Appendix 5. A listing of unscheduled vehicle maintenance is provided in Appendix 6.

Table 2

Summary of the FTP Test Results with Operation as 3-Way Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	0	.92	.91	2.18	7.52	2.08	241.6	13.89	Up to 14
5 Pt: Rh (40)	0	.15	.14***	.21	.78	.84	20.3	14.18	Up to 6
12 Pt: Rh (40)	0	.11	.11***	.33***	.69	.62	11.6	13.97	3
12 Pt: Rh (40)*	0	.13	.14**	.82**	.77	.76	11.4	13.95	2
3 Pt: 2 Pd (20)	0	.15	.15***	N/A	1.47	.85	29.5**	13.78	3
Pd (40)	0	.17	.15***	.35***	1.99	.74	41.5	13.47	3
Pd + BM (35)	0	.28	.27	N/A	2.85	1.97	118.8	14.14**	2
Cu	0	.90	.90	N/A	7.52	1.88	291.9	13.69	2
Pd (20)	0	.18	.18	N/A	1.84	.67	41.0	13.81	3
Ag (150)	0	.54	.53	N/A	6.53	2.03	55.4****	13.85	4

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests
****based on 3 tests

Table 3

Summary of the FTP Test Results with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	3	.92	.81****	2.08	7.26	2.09	264.3	13.93	Up to 5
5 Pt: Rh (40)	3	.14	.14	.59	.60	1.95	15.4	13.75	1
12 Pt: Rh (40)	3	.12	.11	.31	.39	2.01	15.6	14.01	3
12 Pt: Rh (40)*	3	.13	.12	N/A	.40	2.05	14.4	13.74	3
3 Pt: 2 Pd (20)	3	.16	.15	.28	.35	2.07	72.9**	13.43	2
Pd (40)	3	.14	.14	N/A	.38	1.98	68.0	13.43	2
Pd + BM (35)	3	.28	.27	N/A	2.05	1.95	129.4	13.90**	2
Cu	3	.90	.90	N/A	7.29	1.82	322.3	13.44	2
Pd (20)	3	.15	.15	N/A	.40	1.90	94.2	13.83	2
Ag (150)	3	.43	.46***	N/A	5.93	1.99	N/A	13.71	3

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests
****based on 3 tests

Table 4

Summary of the FTP Results with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
				(g/mi)					
None	5	.90	.97***	2.46	7.51	2.09	194.2	13.83	Up to 6
5 Pt: Rh (40)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.12	.12	.32	.40	2.10***	21.0	13.91	4
12 Pt: Rh (40)*	5	.13	.13	N/A	.46	2.09	20.8	13.76	1
3 Pt: 2 Pd (20)	5	.19	.19**	.36	.40	2.03	117.4	13.51	2
Pd (40)	5	.16	.15	N/A	.36	2.05	141.9	13.26	3
Pd + BM (35)	5	.37	.36	N/A	3.66	1.94	279.5	13.85	3
Cu	5	.87	.86	N/A	6.93	1.82	313.9	13.47	2
Pd (20)	5	.13	N/A	N/A	1.31	1.91	104.0	13.70	2
Ag (150)	5	.54	.53	N/A	6.96	1.89	N/A	13.79	1

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Average methanol emissions ranged from 0.21 to 0.82 gram per mile at stoichiometric exhaust conditions and with catalysts. At the 3 percent and 5 percent oxygen levels, methanol emissions with the catalysts ranged from 0.28 to 0.59 gram per mile.

The catalysts which contain rhodium were expected to have significant NOx activity when operated as 3-way catalysts. The other noble metal catalysts also had good NOx activity in these low mileage tests. Based on the performance of vehicles fueled with gasoline, this activity may not be retained over substantial mileage accumulation with the catalysts not having rhodium. As expected, none of the catalysts provided NOx activity under oxidizing exhaust conditions.

Aldehyde emissions were handled much like HC emissions by the catalysts. All the noble metal catalysts showed reductions in aldehydes. Aldehyde levels generally increased as exhaust oxygen level increased.

Catalyst efficiencies were calculated for each catalyst at each exhaust oxygen level. The results of these calculations are presented in Tables 5, 6, and 7. Catalyst efficiency as used here is defined as tailpipe emissions with no catalyst minus tailpipe emissions with a catalyst, the difference divided by tailpipe emissions with no catalyst.

HC efficiencies are greater than or equal to 79% for the noble metal catalysts, except silver, at all exhaust oxygen conditions. CO efficiencies exceed 73 percent for all noble metal catalysts, except silver, at all oxygen conditons. The lowest NOx efficiency for these catalysts (again excluding silver) is 59 percent at stoichometry. No NOx efficiency is

Table 5

CATALYST EFFICIENCY (%)

Oxygen Level at 0%

Catalyst	Efficiency for HC	CO	NOx	Methanol	Formaldehyde
5 Pt: Rh (40)	83	90	60	91	92
12 Pt: Rh (40)	88	91	70	85	95
12 Pt: Rh (40)*	86	90	63	62	95
3 Pt: 2 Pd (20)	83	80	59	N/A	86
Pd (40)	82	74	64	84	83
Pd + BM (35)	70	62	5	N/A	51
Cu	2	0	10	N/A	-21
Pd (20)	80	76	68	N/A	83
Ag (150)	41	13	2	N/A	77

N/A means data are not available
*Racetrack, otners are round

Table 6

CATALYST EFFICIENCY (%)

Oxygen Level at 3%

Catalyst	Efficiency for HC	CO	NOx	Methanol	Formaldehyde
5 Pt: Rh (40)	84	92	7	72	94
12 Pt: Rh (40)	87	95	4	85	94
12 Pt: Rh (40)*	86	94	2	N/A	95
3 Pt: 2 Pd (20)	83	95	1	87	72
Pd (40)	84	95	5	N/A	74
Pd + BM (35)	70	72	7	N/A	51
Cu	2	-1	13	N/A	-22
Pd (20)	83	94	9	N/A	64
Ag (150)	53	18	5	N/A	N/A

N/A means data are not available
*Racetrack, others are round

Table 7

CATALYST EFFICIENCY (%)

Oxygen Level at 5%

Catalyst	Efficiency for HC	CO	NOx	Methanol	Formaldehyde
5 Pt: Rh (40)	N/A	N/A	N/A	N/A	N/A
12 Pt: Rh (40)	86	95	0	87	89
12 Pt: Rh (40)*	85	94	0	N/A	89
3 Pt: 2 Pd (20)	79	95	3	85	40
Pd (40)	82	95	2	N/A	27
Pd + BM (35)	59	51	7	N/A	-44
Cu	4	8	13	N/A	-62
Pd (20)	85	96	9	N/A	46
Ag (150)	40	7	9	N/A	N/A

N/A means data are not available
*Racetrack, others are round

achieved during oxidizing conditions. Aldehyde efficiencies decrease as oxygen level increases. Aldehyde efficiency exceeds 64 percent up to 3 percent oxygen. If rhodium is used in the catalyst, aldehyde efficiency is 89% or higher at all oxygen levels.

The Cu catalyst has little impact on any FTP emission. The silver catalyst has 77 percent aldehyde efficiency at 0 percent oxygen and has modest HC efficiencies.

The palladium plus base metal (Pd + BM) catalyst does not exhibit the NOx efficiency of other Pd catalysts. Also, the HC and CO efficiencies are poorer than for other catalysts which contain Pd. Apparently the amount of palladium present was not utilized as well in this catalyst as in the others.

Evaporative Emissions

A series of SHED tests measuring evaporative emissions were performed in order to determine the effectiveness of activated charcoal canisters in controlling the evaporative emissions of methanol. The results of those tests are summarized in Table 8.

The first six SHED tests, performed on the car equipped with its stock canister, results in average evaporative emissions of 1.74 grams per test. In order to determine the effectiveness of the canister system, two additional SHED tests were performed with the canister vent lines disconnected and vented to the atmosphere. The results of those two tests averaged 1.73 grams per test. Those results seemed to indicate that the original canister was not (at that time) effective in controlling evaporative emissions. Since that lack of effectiveness might have resulted from the canister being saturated, additional testing was performed with the car equipped with new canisters. These tests also yielded results which were of the same order of magnitude. Thus, it appears that the activated charcoal canisters used in these tests are ineffective in controlling evaporative emissions from this methanol-fueled vehicle.

The flame ionization detector (FID) measurements in Table 8 were "corrected" to reflect the assumption that all the HC detected was in the form of methanol (CH_3OH), having a molecular weight of 32.04243. No attempt was made to further "correct" the table values to account for the fact not all the methanol is being measured by the FID. The relative response of the FID to methanol as compared to propane (the hydrocarbon commonly used to calibrate the FID response) has been found to range from 0.73 to 0.85 (3, 4, 5, 6).

Table 8

Evaporative Emissions*

Test Number	Test Date	Heat Build	Hot Soak	Total	Comments
		----grams per test----			
814597	07-08-82	1.0046	1.1030	2.1076	Stock canister (#1)
814678	07-09-82	0.6759	1.0740	1.7499	
814677	07-13-82	0.6618	0.3795	1.0413	
815125	07-30-82	0.8749	1.4208	2.2957	
815163	08-03-82	0.6897	1.0062	1.6959	
815208	08-04-82	0.6708	0.8638	1.5346	
816706	10-27-82	0.7096	0.9141	1.6237	Canister vent lines disconnected
816731	10-28-82	1.0334	0.8125	1.8459	
817499	01-20-83	0.7571	0.7447	1.5018	New canister (#2)
818980	03-25-83	0.8120	0.8512	1.6632	Canister #1 reattached
818982	03-29-83	0.7250	1.0663	1.7913	New canister (#3)
818984	03-30-83	0.7674	0.9322	1.6997	Canister #2 reattached
818986	03-31-83	0.8133	0.8961	1.7094	
818988	04-05-83	0.6585	0.7783	1.4368	
818994	04-08-83	0.7167	0.9193	1.6360	Canister vent lines disconnected

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* FID data "corrected" by assuming all hydrocarbons detected were methanol, having a molecular weight of 32.04243.

Highway Cycle Emissions

The noble metal catalysts, with the exception of silver, provide excellent HC and CO emissions over the highway test as shown in Tables 9, 10, and 11. HC emissions are .010 g/mi or less under all oxygen conditions. CO emissions are also very low at 0.33 or less. As on the FTP, NOx is substantially reduced by the noble metal catalysts, except silver, during stoichiometric exhaust conditions.

The mixed metal catalyst performed well on the highway test. HC and CO were highest at stoichiometry where they were .016 and 1.48 g/mi respectively. Some NOx reduction was also seen.

The copper catalyst showed some HC activity over the highway test. The HC activity increased as the exhaust oxygen level increased. CO, aldehydes, and NOx emissions were not strongly impacted by the copper catalyst. The silver catalyst has substantial HC and modest CO activity. Aldehyde emissions were only measured at stoichiometry, and they were very low (less than 3 mg/mi).

The copper and silver units have shown improved emission control capabilities over the highway cycle as compared to the FTP. Apparently the lack of a cold start and/or the higher catalyst inlet temperatures are permitting the catalysts to be more active. Additional efforts could be expended on these catalysts to further increase catalyst inlet temperature during all driving modes by insulation of the exhaust system.

Exhaust emissions over various steady state conditions were also measured in our testing. These results, from idle to 30 mph, are summarized in Appendix 7.

Table 9

Summary of the Highway Test Results with Operation as 3-Way Catalysts

Catalyst	Oxygen Level (%)	HC (g/mi)	NMHC (g/mi)	Methanol (g/mi)	CO (g/mi)	NOx (g/mi)	Aldehydes (mg/mi)	MPG	Number of Tests
None	0	.428	.419	.693	6.67	2.81	168.3	17.20	Up to 14
5 Pt: Rh (40)	0	.002	.001****	.004	.11	.09	.2	18.08	4
12 Pt: Rh (40)	0	.003	.003	.009***	.05	.61	.5	17.32	3
12 Pt: Rh (40)*	0	.008	.009***	.034***	.06	.55	1.2	17.72	3
3 Pt: 2 Pd (20)	0	.007	.007***	N/A	.22	.64	.9**	17.16	3
Pd (40)	0	.006	.005***	.016***	.33	.51	.7	16.98	3
Pd + BM (35)	0	.016	.012	N/A	1.48	1.63	3.1***	17.59	2
Cu	0	.304	.298	N/A	6.91	2.41	130.7	17.03	2
Pd (20)	0	.009	.007	N/A	.38	.35	1.9***	17.26	3
Ag (150)	0	.024	.019	N/A	4.26	2.74	2.4	17.10	3

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests
****based on 3 tests

Table 10

Summary of the Highway Test Results with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
				(g/mi)					
None	3	.407	.368	.927	6.21	2.81	174.5	17.34	Up to 5
5 Pt: Rh (40)	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	3	.009	.007	.004	.005	2.73	1.2	17.74	3
12 Pt: Rh (40)*	3	.009	.008	.014	.025	2.84	2.0	17.39	3
3 Pt: 2 Pd (20)	3	.010	.007	.014***	.006	2.77	1.7**	16.92	3
Pd (40)	3	.008	.006	N/A	.012	2.65	1.8	17.05	2
Pd + BM (35)	3	.013	.009	N/A	.046	2.60	3.0	17.51**	2
Cu	3	.200	.194	N/A	6.42	2.28	137.2	16.96	2
Pd (20)	3	.008	.005	N/A	.005	2.54	2.7	17.05	2
Ag (150)	3	.019	.014	N/A	3.47	2.64	N/A	17.28	4

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Table 11

Summary of the Highway Test Results with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC (g/mi)	NMHC (g/mi)	Methanol (g/mi)	CO (g/mi)	NOx (g/mi)	Aldehydes (mg/mi)	MPG	Number of Tests
None	5	.398	.431***	0.87	6.30	2.84	141.7	17.30	Up to 6
5 Pt: Rh (40)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.010	.007	.006	.002	2.78****	1.9	17.39	4
12 Pt: Rh (40)*	5	.010	.008	.027	.028	2.80	2.2	17.37	1
3 Pt: 2 Pd (20)	5	.010	.006	.009	.004	2.78	3.0	17.05	2
Pd (40)	5	.009	.006	N/A	.013	2.72	2.7	17.01	2
Pd + BM (35)	5	.014	.009	N/A	.417	2.64	14.5	17.70	2
Cu	5	.150	.144	N/A	6.18	2.21	124.2	16.73	2
Pd (20)	5	.009	.005**	N/A	.003	2.61	2.9	17.03	3
Ag (150)	5	.023	.018	N/A	5.07	2.42	N/A	18.20	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests
****based on 3 tests

Cost and Efficiency per Dollar Estimates

An estimate of the sticker cost of each catalyst in this study has been generated using the methods of reference 7. Sticker cost means the cost to the consumer of the catalyst as it is reflected on the sticker of a new automobile at an automobile dealership. The information in reference 7 has been updated 1) to use 77 percent of the current producer prices for noble metals as stated in the May 13, 1983 edition of American Metal Market - Metalworking News Edition and 2) to account for inflation between 1977 and 1983 at an estimated rate of ten percent per year. We use 77 percent of producer price for noble metals to account for what we estimate are the discounts to the automobile manufacturers due to high volume, long term purchases.

Each catalyst has been evaluated as an oxidizing and 3-way catalyst on an "efficiency per dollar" basis. This means that for an oxidizing catalyst, the previously calculated catalyst efficiencies for HC, CO, and aldehydes were summed and then the total was divided by the estimated sticker cost. The only difference in the calculation for 3-way catalysts is that catalyst efficiency for NOx is added to the HC, CO, and aldehyde efficiencies.

The results of these calculations are presented in Table 12. The estimated sticker costs of the catalysts in our program range from $58 to $150. The costs shown in Table 12 indicate more accuracy in our cost estimates than we would like to convey to the reader. Normally we would round these costs off to the nearest 5 or 10 dollars. In this case, rounding to the nearest 5 dollars would mask real cost differences in the catalysts and would make non-identical catalysts appear to cost the same amount.

Table 12

Sticker Cost and Efficiency per Dollar of Each Catalyst

Catalyst	Sticker Cost ($)	------Efficiency Per Dollar at-------		
		0% Oxygen	3% Oxygen	5% Oxygen
5 Pt: Rh (40)	111	2.92	2.44	N/A
12 Pt: Rh (40)	110	3.13	2.51	2.46
12 Pt: Rh (40)*	150	2.23	1.83	1.79
3 Pt: 2 Pd (20)	75	4.12	3.33	2.84
Pd (40)	72	4.20	3.52	2.84
Pd + BM (35)	70**	2.69	2.75	0.96
Cu	58	-0.16	-0.36	-0.86
Pd (20)	64	4.79	3.78	3.55
Ag (150)	65	2.06	1.10	0.73
Canned substrate only, no catalyst	56	N/A	N/A	N/A

---

* Racetrack others are round
**Does not include the cost of base metals.

Strictly on the basis of the efficiency per dollar calculations, durability selection for 3-way catalysts would be made in the following order of decreasing interest:

Pd (20),
Pd (40),
3 Pt: 2 Pd (20),
12 Pt: Rh (40),
5 Pt: Rh (40),
Pd + BM (35),
12 Pt: Rh (40)*,
Ag (150), and
Cu.

Additional consideration must be included, however, in the selection of durability candidates. First, we must consider that virtually all 3-way catalysts used for gasoline-fueled vehicles contain rhodium. This indicates that rhodium is likely needed for adequate emissions durability. The second consideration is that durability testing is so costly that we may want to test samples with the highest probability of success, not the samples with least cost. With these considerations our first priority samples for durability evaluation as 3-way catalysts are in decreasing order of importance:

5 Pt: Rh (40),
Pd (40), and
3 Pt: 2 Pd (20).

Durability testing with other samples is not recommended. The samples designated Cu, Ag (150), 12 Pt: Rh (40)*, and Pd + BM were omitted on the basis of low efficiency per dollar. The Pd (20) unit was omitted because it is like the Pd (40) catalyst in all respects except that it contains only half as much palladium.

For durability operation as oxidizing catalysts, efficiency per dollar would dictate selections in this order:

at 3% Oxygen	at 5 % Oxygen
Pd (20),	Pd (20),
Pd (40),	Pd (40),
3 Pt: 2 Pd (20),	3 Pt: 2 Pd (20),
Pd + BM (35),	12 Pt: Rh (40),
12 Pt:Rh (40),	
5 Pt: Rh (40),	12 Pt: Rh (40)*,
12 Pt: Rh (40)*,	Pd + BM (35),
Ag (150), and	Ag (150), and
Cu.	Cu.

The selections at 3 percent and 5 percent oxygen are in nearly the same order. Except for the Pd + BM catalyst and one less catalyst to evaluate at 5% oxygen, the order is exactly the same.

Since rhodium content has not been of importance in oxidizing catalyst durability with gasoline-fueled vehicles, our recommendations for durability evaluation of oxidizing catalysts follow the efficiency per dollar calculations more closely. For durability testing as oxidizing catalysts we recommend that the following catalysts be considered as the highest priority samples:

Pd (40), and
3 Pt: 2 Pd (20).

Again the final four samples on the basis of efficiency per dollar were deleted from consideration. The Pd (20) sample again was deleted since it is identical to the Pd (40) sample except that it only has half as much palladium. Durability emissions in theory should be somewhat lower with the Pd (40) catalyst. The Pd + BM sample was not included since it consistently performed at lower efficiencies than the Pd (20) and Pd (40) catalysts.

Summary

Over the FTP:

- Almost no methane is measured in the exhaust.
- Excellent HC and CO control (less than 0.2 and 2.0 grams per mile, respectively) is achieved with all the noble metal catalysts, except silver, at all exhaust oxygen levels.
- All the noble metal catalysts, except silver, achieve NOx levels below 1.0 gram per mile at stoichiometry.
- The addition of base metals to a Pd catalyst did not improve the catalyst.
- CO and NOx control are both poor with the base metal catalyst.

Over the highway cycle:

- Exhaust emissions are generally much less than on the FTP on a gram per mile basis, except for NOx emissions. Excluding emissions with the copper catalyst (which is the least active of all catalysts) and CO emissions with the silver catalyst, little HC, CO, or aldehyde is emitted.

Based on cost, catalyst efficiency, and other considerations, several catalysts have been identified which merit durability testing as 3-way and as oxidizing catalysts. Additional catalysts will be evaluated and additional effort will be expended to improve emissions from catalysts which have performed poorly to date.

References

1. H. Menrad, G. Decker, and K. Weidmann, "Alcohol Fuel Vehicles of Volkswagen", SAE Paper No. 820968, August, 1982, pp 9-12.

2. Status Report of Volkswagenwerk AG Audi, NSU Auto Union AG and Volkswagen of America, Inc., submitted to the Environmental Protection Agency, May, 1981, Volume 1, Section VII.

3. D.L. Hilden and F.B. Parks, "A Single-Cylinder Engine Study of Methanol Fuel - Emphasis on Organic Emissions," SAE Paper No. 760378.

4. R. Bechtold and J.B. Pullman, "Driving Cycle Economy, Emissions, and Photochemical Reactivity Using Alcohol Fuels and Gasoline," SAE Paper No. 800260.

5. H. Menrad, W. Lee, and W. Bernhardt, "Development of a Pure Methanol Fuel Car," SAE Paper No. 770790.

6. G.D. Ebersole and F.S. Manning, "Engine Performance and Exhaust Emissions: Methanol Versus Isooctane," SAE Paper No. 720692.

7. L.H. Lindgren, Cost Estimations for Emission Control Related Components/Systems and Cost Methodology Description, EPA-460/3-78-002, March, 1978, pp 131-134 and pp 147-149.

APPENDIX 1

Vehicle Description

III. RESULTS

A. VEHICLE DESCRIPTION

1981 Volkswagen Rabbit "L" 4-Door Sedan - Model 177243
VI# 1VWF80175BV012728 Engr. Car # 1285

Automatic transmission, air conditioning, 155 80R13 tires, radio and cloth interior. (A vehicle with Vinyl "leatherette" interior was not available at time prototype was built. This may have a small influence on evaporative losses, but this will be negligible once the "new car" background level deteriorates.)

B. DETAILED COMPARISON OF PRODUCTION vs. METHANOL POWERTRAIN AND FUEL SYSTEM

ITEM	1980 PRODUCTION	METHANOL VEHICLE
Basic Engine		
o Type	- 827	- 827
o Displacement	- 1.6 liter (1588cc)	- 1.6 liter (1588cc)
o Bore	- 3.13 inches	- 3.13 inches
o Stroke	- 3.15 inches	- 3.15 inches
o Compression Ratio	- 8.2:1	- 12.5:1 (new pistons)
o Valvetrain	- Overhead camshaft	- Overhead camshaft
o Rated Power	- 76 HP SAE net @ 5500 RPM	- Not measured
o Rated Torque	- 82.7 Ft. lbs. SAE net @ 3200 RPM	- Not measured
o Other	-	- GTI basic engine - European high performance engine to withstand higher loads - U.S. cylinder head.
Fuel System	- Bosch CIS Fuel Injection with Lambda feedback control.	- Same as Production with calibration for Methanol operation.

(Narrative description and schematic of system in Appendix I)

ITEM	1980 PRODUCTION	METHANOL VEHICLE
Fuel System (Continued)		
o Fuel Pump		
Pump Life	- Life of Vehicle	- 6 months to 1 year due to corrosiveness of Methanol.
Other	-	- Improved insulation on wiring exposed to fuel.
o Accumulator		
Maximum holding pressure	- 2.5 Bar	- 3.0 bar (due to fuel difference).
o Fuel Filter		- Bonding glue changed for fuel compatability.
		- One way check valve deleted (Incompatable with fuel).
o Fuel Distributor		
System pressure	- 4.6 - 4.8 bar	- 5.0 - 5.3 bar
Calibration	- Optimized for gasoline	- Optimized for Methanol.
Other	-	- Material changes for fuel compatability.
o Air sensor	-	- Modified airflow characteristics.
o Fuel Injectors	-	- Material change for fuel compatability.
		- Plastic screen replaced by metal screen.
o Cold Start Injector		
Quantity	- One	- Two
Function	- On for start only.	- Cold start valves pulse for 8 seconds beyond start mode, below zero degrees centigrade.

ITEM	1980 PRODUCTION	METHANOL VEHICLE
Other	-	- Calibration changed for Methanol.
		- Material changed for fuel compatability.
Fuel System (Continued)		
o Fuel Injection Wiring	-	- Modified for cold start pulse function and to accomodate relays and thermo switch.
o Air Conditioner Idle Load Compensation	- Ignition distributor vacuum advance controlled.	- Throttle body idle air flow bypass system controlled. (Same as 1982 Production)
o Idle Setting		- Specific to Methanol calibration (See Appendix II)
PCV	- PCV Valve with calibrated plunger and calibrated orifice.	- PCV valve with calibrated plunger - no orifice.
IGNITION		
o Distributor	- Transistor high energy with hall effect and digital idle speed control through spark advance.	- Slightly reduced maximum centrifugal advance and slightly modified vacuum advance/retard characteristics. (See Appendix III)
o Spark Plugs	- Bosch W175T30	- Bosch W260T2-Colder
OIL COOLING	- None	- Heat exchanged from engine oil to cooling water for high loads only (e.g. trailer hauling) not anticipated to be needed in normal operation.

ITEM	1980 PRODUCTION	METHANOL VEHICLE
TRANSMISSION	- Automatic 3-Speed	- Automatic 3-Speed (1981 Production Transmission)
o Torque Converter Ratio	- 2.44	- 2.44
o Stall Speed	- 1900-2200 RPM	- 2000-2200 RPM
o Gear Ratios		
1	- 2.55	- 2.55
2	- 1.45	- 1.45
3	- 1.00	- 1.00
Axle	- 3.76	- 3.57
FUEL TANK		- (European)
o Material	- Steel	- Steel
o Coating	- Terneplate	- Phosphated steel, exterior painted
o Seams & Fittings	- Soldered	- Brazed
o Cap	- Non-Locking	- European neck and locking cap
FUEL	- Unleaded gasoline	- Methanol with 5.5% Isopentane

APPENDIX 2

Formaldehyde Measurement

FORMALDEHYDE MEASUREMENT IN VEHICLE EXHAUST AT MVEL

Robert K. Gilkey

Measurement of exhaust formaldehyde at MVEL is performed using a DNPH (Dinitrophenylhydrazine) technique adapted from that of L.A. Hull[1]. Exhaust carbonyls (including formaldehyde) are reacted with DNPH solution forming hydrazone derivatives. The derivatives are separated directly from the DNPH solution using a liquid chromatograph (LC). Quantization is accomplished with a spectrophometer in the LC effluent stream driving an integrator unit which determines peak height and/or area.

SAMPLING SYSTEM

Figure #1 gives an overall view of the formaldehyde sampling system. Exhaust from the vehicle is ducted to the constant volume sampling (CVS) unit where it is quantitatively diluted with room air. The formaldehyde system draws off a small portion of the diluted exhaust through a probe within the CVS unit. The collection portion is attached directly to the CVS unit to keep the plumbing as short as possible. A flow measurement and control unit is mounted to the wall at the left. The sample pump is mounted to the floor under the flow unit and is not visable.

FIG 1

Figure #2 is a schematic of the sampling system. All of the solenoid valves are electrically connected to the CVS bag sampling switches. Activation of any one of these three switches automatically selects a unique set of impingers (bubblers) and isolates and vents the other two sets. Isolation and venting are required to prevent contamination of the CVS unit or the sample lines.

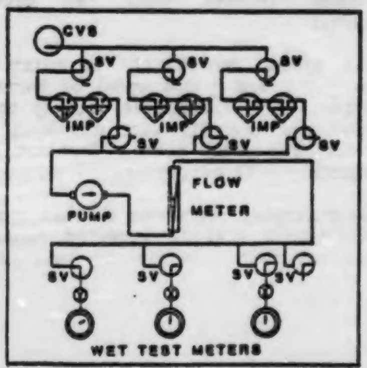


FIG 2 SV-SOLENOID VALVE
IMP-IMPINGER

The sample system is constructed of stainless steel, teflon, and glass upstream of the impingers. This part of the system is also maintained at 100°C. These precautions help prevent loss of formaldehyde within the system. Downstream of the impingers, construction materials and high temperature are not critical.

Two impingers are used in each set. Each is filled with five milliliters (ml) of DNPH solution and immersed in an ice bath during test. Two concentrations of this solution are used depending on the expected exhaust formaldehyde concentration. 0.25 g/l DNPH is used for most catalyst tests while 0.50 g/l DNPH is used for non catalyst tests. The DNPH is dissolved is slightly acidic acetonitrile (ACN).

[1] L.A. Hull, "Procedures for 2, 4 - Dinitrophenylhydrazone Aldehyde-Keytone Air Analysis". Internal EPA, FTP memo, 1981.

Tests have shown that the efficiency of the first impinger is approximately 90% with two liters per minute sample rate.

ANALYSIS PROCEDURE

Upon completion of vehicle testing, the impingers are removed from the sampling system and refilled to 5 ml with ACN. Each impinger is permanently marked at 5 ml to facilitate this operation which restores evaporation loss. The solution is then transfered directly to a glass vial with a teflon lined septum which is compatible with the LC autosampler.

Separation of the carbonyl derivatives is done using a Waters Associates M-6000A chromatography pump with a Varian Micro pak MCH-10 reversed phase 30 cm x 4 mm column. A mixture of 65% ACN / 35% water is used as the carrier at a flow rate of 2 ml/minute. The column feeds directly into the primary absorbance cell of a Varian 635 UV-Visible spectrophotometer set to 360 nm wavelength. Sample injection is made through a 10 ul loop.

An overall view of the analysis system is shown in figure #3. The system is semi-automatic. (Baseline drift must be monitored and corrected during long runs to keep the integrator from being driven out of its range.)

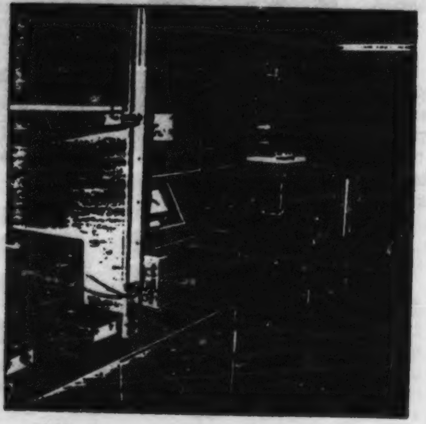


FIG 3

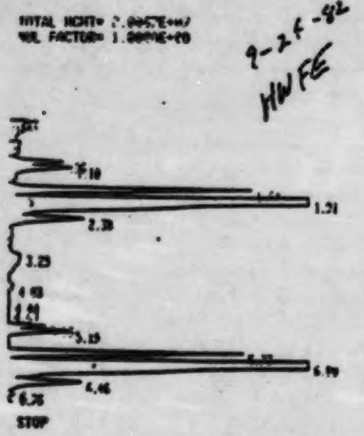
Quantification is done using peak-height rather than area. Experiments indicate better repeatablility and more consistant results with this method. The Hewlett Packard 3390A integrator permits reports in either peak-height or area or both.

Standards are run prior to each group of test vials to be analyzed. At least three are used to bracket the expected concentrations and a calibration curve is drawn. Generally this curve is linear, though corrections are made if it is not. (Non-linearity occurs when vehicle test conditions produce concentration differences greater than two orders of magnitude.)

Analysis system sensitivity is noise limited between ± 0.2 and ± 0.8 ug/ml of formaldehyde derivative. This translates roughly to 0.2 to 0.8 mg/mi for the FTP test and 0.05 to 0.25 mg/mi for the HWFE test. Repeatability is approximately ± 5% or better.

During test sample analysis, the Dupont 834 Automatic Sampler sequences a flush vial and a sample vial pair to the injection station. Every sample vial is injected twice. Each sample is allowed to elute for four minutes before the next injection or pair is introduced. The sampler will hold up to 47 pairs.

The Hewlett Packard 3390A Integrator is started upon injection of the first sample vial and allowed to run continuously until the last vial is finished. This unit generates a continuous trace of the spectrophotometer output anotated with the apparent retention time of each peak distinguished. A report is generated at the end of each run. This report gives peak information keyed to the retention time. The "formaldehyde" peaks are easily separated from the others by their relation to the DNPH peak. The integrator will hold information on over 1000 peaks which is adequate for very long runs. A typical vehicle vial analysis report is shown in Figure #4. Two injections were made of the same vial. The peaks at 2.38 and 6.46 minutes are formaldehyde/DNPH derivative. Unreacted DNPH peaks are at 1.91 and 6.00 minutes. (All three peaks preceding DNPH are tentively identified as species of NOx.) (In this case the vehicle was methanol fueled and equipped with a catalyst.) The total formaldehyde derivative concentration from the exhaust for this test was calculated as 3.1 ug/ml.



9-28-82
HWFE

```
RUN #  13                    SEP/28/82  05:00:34

HEIGHT%
   RT      HEIGHT   TYPE   AR/HT   HEIGHT%
  0.96     181463     PV   0.838     0.932
  1.10     210276   D VP   0.122     1.080
  1.64     860928    SP8   0.099     4.422
  1.91    8132900    SP6   0.133    41.774
  2.38     223822     BP   0.116     1.150
  3.29      48386     VV   0.447     0.249
  4.03      36025     VP   0.199     0.189
  4.44      24962     VV   0.170     0.128
  4.69      20429     VV   0.105     0.105
  5.96     151201     VV   0.091     0.779
  5.19      24649   D VV   0.101     1.866
  5.73     876831    SP2   0.103     4.584
  6.00    8201920     SH   0.132    42.129
  6.46     232878    TBB   0.119     1.196
  6.76      20702   D BP   0.095     0.106
```

FIG 4

STANDARDIZATION

Standards are made by quantitative dilution from crystaline formaldehyde/DNPH derivative. This derivative (Formaldehyde 2, 4-Dinitrophenylhydrazone) is produced by reacting 40% aqueous formaldehyde solution with a hot saturated solution of 2, 4-DNPH in methanol. A drop of HCl is added and the derivative is precipitated with water. The crystals are filtered and recrystalized from a mixture of 3 parts methanol to 1 part water.

Primary liquid standards are made at 500 ug/ml and 200 ug/ml by dissolving the dried derivative in HPLC grade ACN. A micro balance is used for this operation. Successive dilution of the primary standards is used to give at least 10 concentrations down to 0.5 ug/ml. Once in solution, the standards are monitored for stability.

CALCULATIONS

Data are reported in terms of total formaldehyde per test phase and total formaldehyde per mile driven during the test phase. The primary equation is:

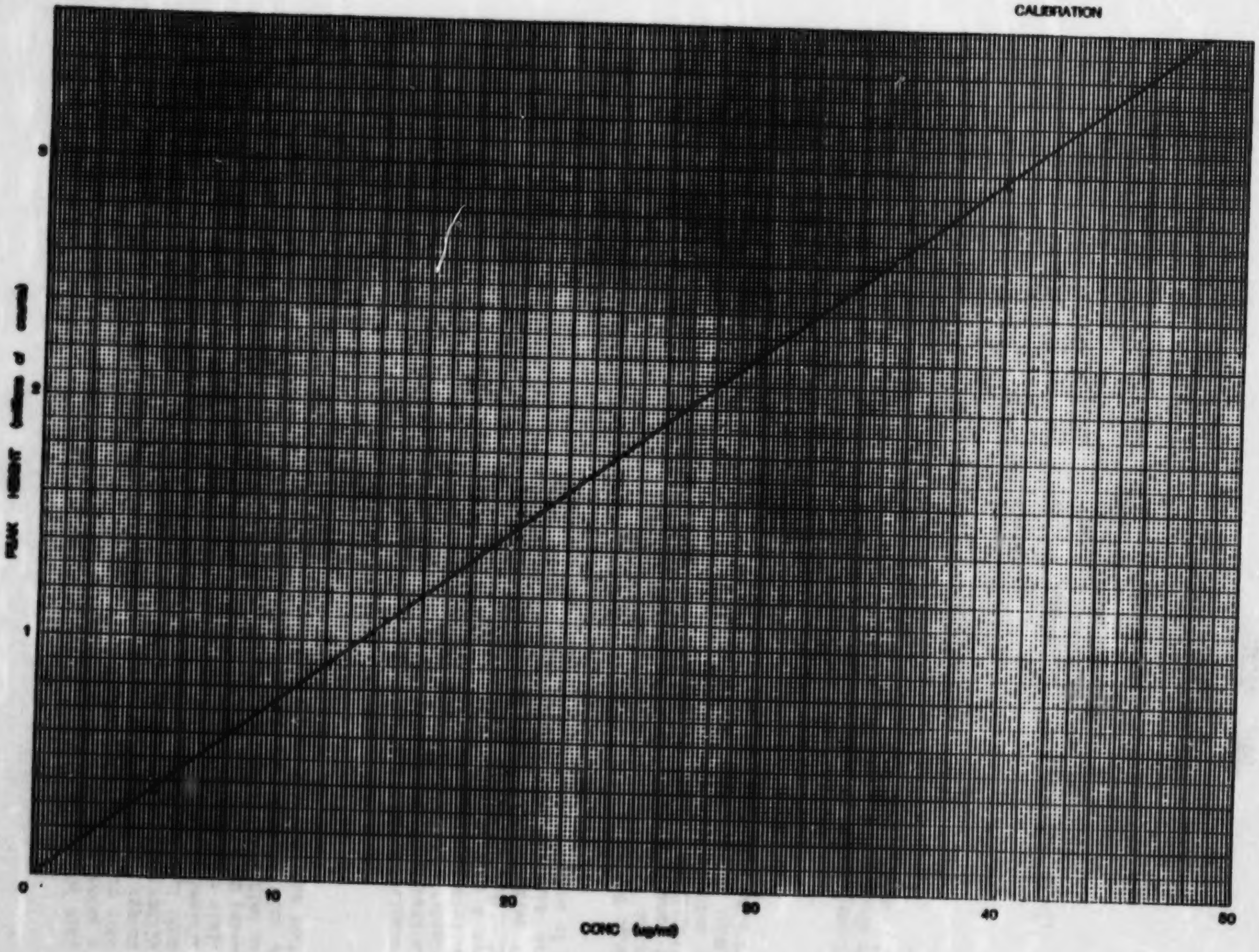
$$mg_F/mi = \frac{(.004046 * CCNC * V_{imp} * VMIX)}{(VS * D)}.$$

Where;

CCNC = Concentration of derivative (ug/ml)
V_{imp} = Volume of impinger fluid (ml)
VMIX = Total CVS flow (ft^3)
VS = Volume of sample taken (l)
D = Distance driven during test (mi)

$$.004046 = \frac{MW_{Formaldehyde}}{MW_{Derivative}} * \frac{1/ft^3}{ug/ml}$$

$$= \frac{30.011}{210.04} * \frac{28.316}{1000}$$



9/28/82

CALIBRATION

"CONC"	is determined from the formaldehyde peak height counts for each sample vial. The "best" peak is chosen from the two for each vial. If both are good, the last is chosen. The calibration curve for the run is then used to obtain the concentration from the height counts. "Best" is determined from integrator peak information and visual inspection.
"V_{imp}"	is held constant at 5 ml of DNPH sampling solution in each impinger. Evaporation of the ACN solvent during test is a problem despite the ice bath in which the impingers are placed. The loss is always made up before the solution is transfered to the sample vials. Transfer of DNPH solution between or out of the impingers due to pressure imbalances is prevented by the isolating and venting solenoids.
"VMIX"	is obtained directly for each test from the CVS control unit. The value represents the total volume of dilute exhaust produced by the vehicle during a test. VMIX is presented at standard conditions of 760 mm Hg and 68.0°F.
"VS"	is measured by Precision Scientific 63111 or 63115 wet test meters. The meters are calibrated at nominal MVEL pressure and temperature conditions of 736 mm Hg and 73°F to correct readings to the above conditions. Corrections to actual test conditions are minimal and are neglected.
"D"	is obtained as roll revolutions from the dynamometer control unit. A calibration factor is used to convert this reading to miles. This calibration rarely changes.
"MW"	(Molecular Weight) for both formaldehyde and its DNPH derivative were calculated from their molecular formulas and generally available atomic weights. The formulas are: 2, 4-Dinitrophenylhydrazine (DNPH)........ $H_2NNHC_6H_3(NO_2)_2$ Formaldehyde................................ OCH_2 Formaldehyde 2, 4-Dinitrophenylhydazone... $CH_2NNHC_6H_3(NO_2)_2$ One mole of formaldehyde reacts with one mole of DNPH to give one mole of derivative plus one mole of water.

A standard work sheet is used to collect data and report results. The results may be calculated from the equations and conversions given on the sheet. A "BASIC" program for the Apple Computer has been developed to complement the work sheet. This program generates a calibration equation of the form: Conc = A3*(Counts)^2 + A2*(Counts) + 0. The curve is forced through zero, zero. The coefficients are then used in the reduction program presented in Figure 8.

FORMALDEHYDE ANALYSIS WORKSHEET

CH_2O Emiss = (.004046 * Conc * V_{BUB} * VMIX)/(V_S * Dist)

TEST #__________ DATE 9-24-82

		CONVERT	UNITS		Bg 1	Bg 2	Bg 3	FTP Tot	HWFE	IDLE	20 mph	30 mph	40 mph	
DMPH Vol.	1		ml	V_{BUB}					5					
	2													
Samp. Vol.	3		ft^3						0.833					
	4	* 28.316	1	V_S					23.60					
	5													
VMIX	6		ft^3	VMIX					4115					
	7													
Distance	8		Roll Rev						23823					
(Cal.)	9	/(RR/mi)							2331.57					
Distance	10		mi	Dist					10.218					
	11													
Defl.	12								232,998					
Range	13								[illegible] 0.5"					
Raw Conc.	14		ug_D/ml	Conc					3.13					
Bag Conc.	16		ppm_F											
Bag Conc.	17		$mg_F/1$											
	18													
Tot. CH_2O	19		mg_F						11.041					
	20													
CH_2O Emiss	21		mg_F/mi	CH_2O E.					1.1					
	22													
Wt. FTP	23	Dist	mi											
	24	* Wt			0.5	1.0	0.5							
	25		Wt mi											
	26													
	27	Tot. CH_2O	mg_F											
	28	* Wt			0.43	1.00	0.57							
	29		Wt Tot											
	30													
	31	Wt Emiss.	$\frac{\text{Wt Tot}}{\text{Wt mi}}$											

FIG 8

```
]RUN FMALD.EPA
     FORMALDEHYDE DATA REDUCTION



CAL DATA

   A(1) = 0
   A(2) = 9.55983598E-06
   A(3) = 1.59070037E-12


ARE THESE THE RIGHT COEFF'S ? (Y/N) Y



TEST DATA


         USE 'Q' TO QUIT 'R' TO REDO


 DNPH VOLUME (ML) ? 5
 VB = 5 ML

 SAMPLE VOL (CU FT OR L) ? .832
 VS = .832 CU FT
 VS = 23.558912 LITERS

 VMIX (CU FT) ? 4126
 VMIX = 4126 CU FT

 ROLL REVS ? 23926
 ROLL REVS = 23926
 DISTANCE = 10.261755 MILES

 PEAK HEIGHT COUNTS ? 217547
  PEAK HEIGHT COUNTS = 217547
 CONCENTRATION = 2.15 UG/ML

 CH2O EMISS = .74 MGM/MI

  TOTAL CH2O = 7.64 MGM

ID FOR THIS VIAL? 9-28-82 HWFE
HIT RETURN TO CONTINUE
TEST DATA


         USE 'Q' TO QUIT 'R' TO REDO
```

FIG. 7

```
]LOAD FMALDPR#0
]LIST

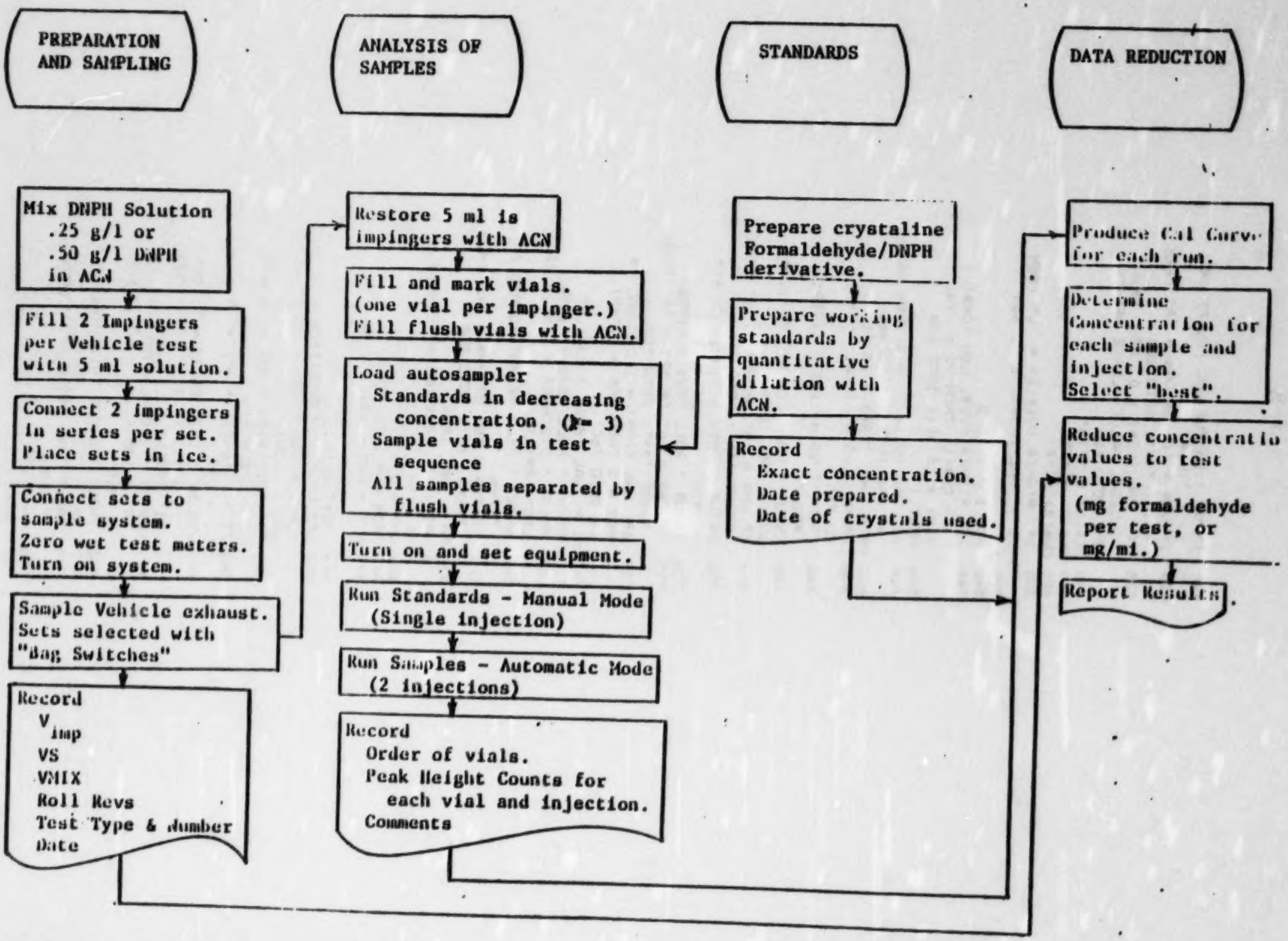
20 HE$ = "FORMALDEHYDE DATA REDUC
     TION"
30  REM : PR#4
40  HTAB 20 - ( LEN (HE$) / 2): PRINT
     HE$: PRINT : PRINT
80  INVERSE : PRINT "CAL DATA": NORMAL
     : PRINT
100 NS = 3
102 D$ =  CHR$ (4): REM  CONTROL
     D
104  PRINT D$;"OPEN COEFF, L45"
106  PRINT D$;"CLOSE COEFF"
108  PRINT D$;"OPEN COEFF, L45"
110  FOR I1 = 0 TO NS - 1
112  PRINT D$;"READ COEFF, R0, B"
     ;I1 * 15
114  INPUT AS(I1 + 1): NEXT I1
116  PRINT D$;"CLOSE COEFF"
118  GOTO 200
120  INPUT "   A(1) = ";AS(1)
140  INPUT "   A(2) = ";AS(2)
160  INPUT "   A(3) = ";AS(3)
180  PRINT
200  HOME : INVERSE : PRINT "CAL
     DATA": NORMAL : PRINT
220  PRINT "   A(1) = ";AS(1)
240  PRINT "   A(2) = ";AS(2)
260  PRINT "   A(3) = ";AS(3): PRINT
     : PRINT
262  INPUT "ARE THESE THE RIGHT C
     OEFF'S ? (Y/N) ";IN$
264  IF IN$ = "N" GOTO 120
266  IF IN$ <  > "Y" GOTO 262
268  PRINT : PRINT
280  HOME : INVERSE : PRINT "TEST
      DATA": NORMAL : PRINT : PRINT

290  HTAB 10: PRINT "USE 'Q' TO Q
     UIT 'R' TO REDO"
291  PRINT : PRINT
300  INPUT " DNPH VOLUME (ML) ? "
     ;VB$
320  IF VB$ = "" THEN VB$ = "5"
330  IF VB$ = "Q" THEN  END
335  IF VB$ = "R" THEN  PRINT "**
     ": GOTO 280
340  IF VB$ = "5" THEN  GOTO 400
360  INPUT " VALUE IS NORMALLY 5
     - IS YOUR VALUE GOOD ? (Y/N)
      ";IN$
365  PRINT "CHR$ (7): PRINT CHR$
     (7) REM BELL
370  IF IN$ = "5" THEN IN$ = "5":
      GOTO 400
380  IF IN$ = "N" THEN  GOTO 300
390  IF IN$ <  > "Y" GOTO 300
400 VB =  VAL (VB$): PRINT " VB =
     ";VB;" ML": PRINT
```

Fig. 8

```
420  INPUT " SAMPLE VOL (CU FT OR
      L) ? ";VS$
430  IF VS$ = "Q" OR VS$ = "R" THEN
      PRINT "**": GOTO 280
435  IF  VAL (VS$) = 0 THEN  PRINT
     "ILLEGAL VALUE-PLEASE REENTE
     R": GOTO 420
440 CK$(1) = "FT3"
460 CK$(2) = "FT"
480 CK$(3) = "F"
500  IF  RIGHT$ (VS$,1) = "L" THEN
     VS =  VAL (VS$): GOTO 660
520 :
540  FOR I = 1 TO 3
560  IF  RIGHT$ (VS$, LEN (CK$(I)
     )) = CK$(I) THEN VS =  VAL (
     VS$) * 28.316: GOTO 640
580  NEXT I
600  IF  VAL (VS$) >  = 8 THEN VS
      =  VAL (VS$): GOTO 660
620 VS =  VAL (VS$) * 28.316
640  PRINT " VS = "; VAL (VS$);"
     CU FT"
660  PRINT " VS = ";VS;" LITERS":
      PRINT
680  INPUT " VMIX (CU FT) ? ";VM$
     :VM =  VAL (VM$)
690  IF VM$ = "Q" OR VM$ = "R" THEN
      PRINT "**": GOTO 280
700  PRINT " VMIX = ";VM;" CU FT"
     : PRINT
720  INPUT " ROLL REVS ? ";RR$
725  IF RR$ = "Q" OR RR$ = "R" THEN
      PRINT "**": GOTO 280
730  IF  VAL (RR$) = 1 OR  VAL (R
     R$) = 0 THEN RR$ = "0":MI =
     1: GOTO 760
740 MI =  VAL (RR$) / 2331.57
760  PRINT " ROLL REVS = ";RR$
780  PRINT " DISTANCE = ";MI;" MI
     LES": PRINT
800  INPUT " PEAK HEIGHT COUNTS ?
      ";PH$
810  IF PH$ = "Q" OR PH$ = "R" THEN
      PRINT "**": GOTO 280
820 PH =  VAL (PH$)
825  PRINT "  PEAK HEIGHT COUNTS
     = ";PH
840 AMT = 0
842  FOR L = 1 TO NS
844 AMT = AMT + AS(L) * PH ^ (L -
     1)
846  NEXT L
850  PRINT " CONCENTRATION = "; INT
     (AMT * 100 + .5) / 100;" UG/
     ML": PRINT
860 FE = (.004046 * AMT * VB * VM
     ) / (VS * MI)
880 FT = (.004046 * AMT * VB * VM
     ) / VS
900  PRINT " CH2O EMISS = "; INT
     (FE * 100 + .5) / 100;" MGM/
     MI": PRINT
920  PRINT "  TOTAL CH2O = "; INT
     (FT * 100 + .5) / 100;" MGM"
     : PRINT
930  INPUT "ID FOR THIS VIAL? ":I
     N$
940  INPUT "HIT RETURN TO CONTINU
     E";IN$
950  GOTO 280
960  END
```

Fig. 8 (cont'd)


PREPARATION AND SAMPLING
ANALYSIS OF SAMPLES
STANDARDS
DATA REDUCTION
Mix DNPH Solution .25 g/1 or .50 g/1 DNPH in ACN
Fill 2 Impingers per Vehicle test with 5 ml solution.
Connect 2 impingers in series per set. Place sets in ice.
Connect sets to sample system. Zero wet test meters. Turn on system.
Sample Vehicle exhaust. Sets selected with "Bag Switches"
Record V$_{imp}$ VS VMIX Roll Revs Test Type & Number Date
Restore 5 ml is impingers with ACN
Fill and mark vials. (one vial per impinger.) Fill flush vials with ACN.
Load autosampler Standards in decreasing concentration. (N= 3) Sample vials in test sequence All samples separated by flush vials.
Turn on and set equipment.
Run Standards - Manual Mode (Single injection)
Run Samples - Automatic Mode (2 injections)
Record Order of vials. Peak Height Counts for each vial and injection. Comments
Prepare crystaline Formaldehyde/DNPH derivative.
Prepare working standards by quantitative dilation with ACN.
Record Exact concentration. Date prepared. Date of crystals used.
Produce Cal Curve for each run.
Determine Concentration for each sample and injection. Select "best".
Reduce concentratio values to test values. (mg formaldehyde per test, or mg/ml.)
Report Results

Procedures for 2,4-Dinitrophenylhydrazone Aldehyde-Ketone Air Analysis

L.A. Hull, Dept. of Chemistry, Union College, Schenectady, New York,
on leave at U.S. EPA, in Gas Kinetics and Photochemistry Branch
Mail Drop 84, RTP, NC 27711

6/30/82

I. Reagents:

A. 2,4-Dinitrophenylhydrazine (DNPH) - Commercially available DNPH is recrystallized 2-3 times from HPLC grade acetonitrile (ACN)(Burdick and Jackson). To 50 ml of the ACN is added 3 gms of the DNPH. The solution is brought to a boil and decanted from any solid residue, allowed to cool to room temperature and then placed in an ice bath. The crystals are isolated by suction filtration with a minimum of atmospheric exposure to prevent the introduction of contaminants.

B. Sampling Solutions:

1. Ambient sampling (low ppb levels): In a 1.0 l volumetric flask 0.25 g of purified DNPH is dissolved in 1.0 l of HPLC grade ACN. To the resulting solution is added 0.2 ml of concentrated H_2SO_4.

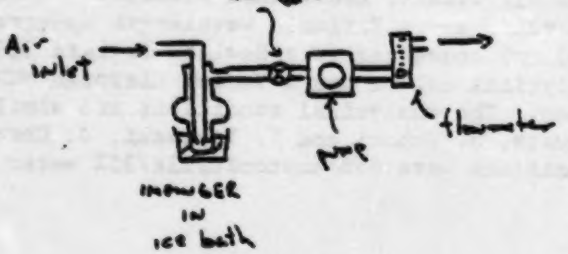
2. Laboratory sampling (ppm levels): The above concentrations are doubled.

II. Sampling Procedures:

A. Apparatus: A schematic of the apparatus is shown in Figure 1. The pump, flow controller, and flow meter all come after the impinger. The impinger is a non-frit type with the bubble tip within 3.0 mm of the bottom. The impinger should be calibrated for 2.0 and 4.0 ml of solution.

B. Ambient Samples: Without the bubbler the flow rate is adjusted for about 0.5 l/min with the needle valve. To the impinger is added 4.0 ml of the "ambient" sampling solution. The impinger is connected to the pump and the inlet lines and placed in an ice bath up to the level of the DNPH solution. The pump is then turned on and the flow readjusted to 0.5 l/min. The sampling continues for 60 minutes (30 liters). After

Figure 1. Schematic of DNPH sampling apparatus



sampling is complete the impinger is disconnected from the pump and inlet lines, caped and the solution warmed to room temperature. With the caps off the impinger the solution is made up to the 2.0 ml mark on the impinger by the addition of ACN through the inlet portion of the impinger. This serves to fix the final volume for concentration calculations latter and wash any material that collects before the sampling solution into the solution. The solution is then transferred to a teflon caped vial.

C. Laboratory sampling: The apparatus is the same except no ice bath is needed. Only 2.0 ml of DNPH laboratory sampling solution is required in the impinger and the sampling rates are from 0.1-0.5 l/minute with the total volumes from 0.25-2.0 l depending on how high the concentrations are. With the solution as constituted it would be best to keep the product of the carbonyl concentrations times the volume sampled less than 10 ppm-liters (10,000 ppb-liters) and the optimal product is 0.50 ppm-liter. For example if the carbonyl compound is at 0.5 ppm then a good sample size would be 1.0 l with the maximum being 20. liters. Another limitation arises if an accurate analysis of ketones is desired. In that case the amount of moisture introduced must be kept less than 50 microliters in the 2.0 ml of solution. The sampling volume may then be determined by taking into account the humidity of the air. After sampling the solution is made up to 2.0 ml with ACN addition (as described before) and then transferred to a teflon caped vial.

III. Analysis:

A. Standardization: Standards can be prepared in two ways.

1. Solid 2,4-Dinitrophenylhydrazones: Using standard methods (N.D. Cheronis, J.B. Entrikin, and E.M. Hodnett, Semimicro Qualitative Organic Analysis, 3rd Ed. Interscience Publishers, New York, 1965, pg. 499-501) the crystalline 2,4-dinitrophenylhydrazones of a number of the ketones and aldehydes were prepared. Weighed samples were then made up to known concentrations in ACN solution (approximately 2. X 10^{-3} M) and the solutions used as standards.

2. Direct addition of the carbonyl compound to the reagent solution:

A measured volume of a liquid carbonyl compound (usually 1.0 microliter) is added to ACN (2.0 ml). An aliquot (usually 4.0 microliters) of that solution is then added to 2.0 ml of the laboratory sampling solution. Using the density of the carbonyl compound the concentration of the carbonyl compound (actually the 2,4-dinitrophenylhydrazone derivative) in the sampling solution can be calculated and the resulting solution used as a standard.

B. Analytical conditions: A Varian 5000 HPLC liquid chromatograph equipped with a built-in 254 nm ultraviolet absorbance detector connected to a Hewlett-Packard 7132A recorder, and a Variable Wavelength Spectra Physics SF 770 UV detector (set for 360 nm) connected to a Hewlett-Packard 3380S integrator were used. The analytical column was a Varian Micropak MCH-10 reversed phase 30 cm x 4 mm column. The analytical conditions are similar to those already described (K. Kuwata, M. Uebori and Y. Yamasaki, J. Chrom. Sci., 17, 264 (1979)). The HPLC conditions were 65% acetonitrile/35% water (currently the analysis is done with 64% acetonitrile/36% water to compensate for some column degration) with a flow rate of 1.5 ml/min. In Table 1 are listed the retention times and calibration factors for those common compounds for which standards have been run. The standardization factors are based on a 30 l air sample having deposited its aldehydes/ketones in 2.0 ml of the DNPH reagent solution. For smaller air samples or larger volumes of collecting solution proportional factors can be used with the standardization figures in Table 1. In Table 2 are listed the retention times and standardization factors for some terpene carbonyl compounds run with solvent programming as follows: flow 1.5 ml/min, 65% ACN/H_2O-5 minutes, 65 to 75% ACN over the next 10 minutes.

C. Analytical Procedures: The sample solutions are transferred to a heavy-walled 2.0 ml reaction vessel fitted with a teflon cap (Supelco, Inc., Bellefonte, PA) and heated 15 mins in a water bath at about 70-80°C. The solution is then injected into the HPLC via a 10 microliter sampling loop. The solution is heated for another 15 minutes and the analysis repeated until successive injections agree to within 10%. For aldehydes the development is usually complete in 10-15 minutes. For simple ketones 30 minutes usually suffices, while the dicarbonyl compounds require as much as 3 hours heating.

Using the standardization factors and retentions times the peaks can be assigned and quantified. Because the formaldehyde peak overlaps the tail of the unreacted DNPH reagent the integration obtained is often distorted by baseline triggering problems. For a reliable formaldehyde concentration it is best to draw a baseline and use the absorbance measurement to determine the concentration.

1. Ambient samples: Because all the ambient samples are likely to contain significant quantities of water (greater than 0.2 ml) the ketone responses are virtually completely suppressed by the equilibrium shown below while the

$$\rangle C = O + H_2N\text{-}NHDNP \overset{H^+}{\rightleftharpoons} \rangle C = NNHDNP + H_2O$$

aldehyde responses are approximately 90% of their true ambient values. This result was obtained from experiments in which water was deliberately added, as well as sampling from moist bag samples. The data on ambient samples can then be handled as all aldehyde analyses and the values obtained as being approximately 90% of the true ambient values.

For high boiling (greater than 150-200°C) ketones (in particular the terpene carbonyl compounds) it is possible to evaporate off all the solvent (ACN and water) from the sample solution by gently heating the solution in a 10 ml beaker on a hot plate (remove the solution before the last of the solvent evaporates and let it do so without further heating). Redissolving the residue in 2.0 ml (or less, if enhanced sensitivity is desired) pure ACN removes the water interference problem.

2. Laboratory samples: If the quantity of water in the sample (as determined by the humidity of the sampled air and the volume sampled) is less than about 50 microliters/2.0 ml of sampling solution there is little if any interference in the analysis of any aldehyde or ketone so far sampled. Using 2 bubblers, bag sampling, and FT-IR cross checking of concentrations indicates collection efficiences are 100% as far as it can be determined for all the varieties of compounds listed in Tables 1 and 2 from the low ppb range up to several ppm.

3. Interferences: Besides the water interference in ketone analyses, as mentioned above, there is also a potential interference of simple aromatic compounds with the HPLC analysis at 254 nm. Because the 254 UV absorbance detection is sensitive to the presence of aromaticity, any species that collects in the ACN solutions and possesses an aromatic ring can potentially interfere with the 254 nm analysis. As a practical matter only benzene, toluene, (RT 3.74 min) and the xylenes (RT 4.5 min) are likely interferences. The 254 detector is 1/25 as sensitive to the above compounds as to the DNPH derivatives so only high concentrations would interfere with the analysis of particular carbonyl compounds. The use of 360 nm detector eliminates any such potential interference.

In experiments to date no interferences of O_3 (less than 0.5 ppm), NO (less than 5 ppm), NO_2 (less than 5 ppm), and HONO (less than 5 ppm) have been observed in the 1-2 liter laboratory sampling and none have been observed with ambient sampling.

IV. General Comments: The above described method for ambient aldehyde and laboratory aldehyde/ketone analyses is simpler than the aqueous impinger method described in the literature (see above, K. Kuwata reference) since it involves no extractions (which introduce solvent contamination problems and small volume handling problems) and in addition is efficient at collecting and quantifying carbonyl compounds of six or more carbons. In tests of the aqueous impinger method it was found to give, in our hands, less than 10% of the known gas phase concentration of benzaldehyde. Also even for high concentration ("laboratory") runs on ketones, because of the presence of water (as solvent) the aqueous impinger method was not useful for ketone determinations. While the above described method has drawbacks it is a useful tool for ambient aldehyde measurements and quite useful for aldehyde/ketone measurements in experiments where the water concentrations relative to the aldehyde/ketone concentrations are in the appropriate range.

The use of 360 nm detection (instead of 254 nm) also improves the sensitivity of the analysis. The increased sensitivity could allow 15 l ambient samples or 30 min sampling time and it eliminates any potential interferences from simple aromatic compounds. For laboratory analyses this will increase the sensitivity for which there is no water interference.

For routine analyses of high concentration samples (auto exhaust for example) where carbonyl compounds may be 1-10 ppm range it should be possible to use 10-20 ml of the DNPH/ACN sampling solution ("laboratory") and collect 1-2 liters of exhaust over some convenient time (30 minutes). The resultant DNPH derivative concentrations should be ample and the water interference minimal (assuming the water is less than about 250 torr).

Care must be taken in the sampling to not unduly obstruct the flow of air into the sampling solution. It has been observed that significant decreases in the aldehyda/ketone concentrations (when in the ppb range) are observed if the gas sample passes through a simple 1 micro teflon filter.

Table 1. Retention Times and Calibration Factors for Simple Aldehyde/Ketone 2,4-Dinitrophenylhydrazones

Compound (DNPH derivative)	Retention Time (Mins) 254 nm	Absorption Cal. (ppb/Abs. unit, x 10^{-3}) 254 nm	Integration (counts/ppb) 254 nm	Integration** (counts/ppb) 360 nm
2,4-DNPH	2.47	—	—	—
Formaldehyde	3.22	2.92	1358	5437
Acetaldehyde	3.77	3.60	1313	5396
Propionaldehyde	4.51	4.91	1128	4726
Acetone	4.46	4.54	1224	5033
i-butyraldehyde	5.40	4.84	—	6327
methyl vinyl ketone	5.15	4.74	1540	—
crotonaldehyde	5.20	4.00	1819	5958
methacrolein	5.29	4.17	1651	6393
methyl ethyl ketone	5.70	5.50	1248	5138
cyclopentanone	5.75	6.3	1287	—
glyoxal	5.98	4.40	2066*	3502*
benzaldehyde	6.45	5.94	1433	4929
cyclohexanone	6.88	6.20	1426	—
o-tolualdehyde	7.51	7.76	1417	4331
methylglyoxal	8.25	5.50	2066*	3502*
hexanal	8.72	9.47	1228	5357
biacetyl	11.75	9.00	2066	3502

* Biacetyl was used as a reference to standardize these compounds which come as aqueous solutions.

** The retention times on the 360 nm detector are 0.1–0.3 minutes longer than the 254 detector since the 360 detector is "downstream" from the 254 detector.

Table 2. Retention Times and Calibration Factors for Terpene Carbonyl Compound with Solvent Programming

Compound (DNPH derivative)	Retention Time (mins) 254 nm	Absorbance Cal. (ppb/Abs, X 10^{-3}) 254 nm	Integration (counts/ppb) 254 nm	Integration (counts/ppb) 360 nm
c-pinonic acid	4.02	4.18	1478	5114
c-pinonaldehyde (mono DNPH)	5.54	—	—	—
nopinone	10.0	9.85	1012	3766
c-pinonaldehyde	13.60	5.42	1717	8629

APPENDIX 3

Fuel Analysis

SOUTHWEST RESEARCH INSTITUTE
POST OFFICE DRAWER 28510 • 6220 CULEBRA ROAD • SAN ANTONIO, TEXAS, USA 78284 • (512) 684-5111•TELEX 76-7357

May 6, 1983

Mr. Carl Scarbro
EPA
2625 Plymouth Rd.
Ann Arbor, MI 48105

Dear Mr. Scarbro:

We have completed the tests you requested on your Batch 100 methanol sample. The results were:

Test	**Results**
Heat of Combustion (ASTM D-240)	
Gross	10,292 Btu/lb
Net	9,143 Btu/lb
Water Content by Karl Fischer Titration (ASTM D-1744) wt. %	0.055%
API Gravity (ASTM D-287)	46.9° @ 60°F
Density (ASTM D-287)	0.7928 @ 15°C
Flash Point (ASTM D-93)	71.9°F
Acid Number (ASTM D-664) equiv. mg KOH/g sample	0.00
Lead by A.A. (ASTM D-3237)	3 ppm
Sulfur by Dohrmann Microcoulometer	N.D. (<0.001%)
Phosphorous by A.A.	1.7 ppm
Higher Alcohols by G.C.	N.E. (<0.1% ea.)

N.D.: None detected

SAN ANTONIO, TEXAS
WITH OFFICES IN HOUSTON, TEXAS, AND WASHINGTON, D.C.

All the above tests were performed in duplicate and the averages reported. The prices billed for these tests reflect an across-the-board price increase for our Division which became effective on October 1, 1982. As I mentioned in our telephone conversation, we performed these analyses last November (1982), but have held the results pending approval of payment-in-full for a previous purchase order (No. A-0579-NNSX) performed for Mr. Bill Clemmens, also dating from last November.

If you have any further questions, you may call me at (512) 684-5111, ext. 2144.

Sincerely,

Joseph Brock Fischer

Joseph Brock Fischer
Research Scientist
Engines, Fuels & Lubricants
Dept. of Petroleum Research

JBF/ygc

APPENDIX 4

Individual Test Data

NUMBER	O2	CAT#	DATE	ODOM	TPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814210	9	STOCK	6-23-82	2605.0	FTP	20.2	14.1591	0.1902	0.7539	289.14	N/A	N/A	0.169
814211	9	STOCK	6-24-82	2624.0	FTP	17.4	14.1227	0.1356	0.6957	289.86	N/A	N/A	0.142
814212	9	STOCK	6-29-82	2652.4	FTP	17.2	14.1052	0.1511	0.9001	290.40	0.5941	N/A	0.208
814597	9	STOCK	7-08-82	2908.0	FTP	N/A	13.9216	0.1429	0.8150	294.50	0.5458	0.1398	N/A
814678	9	STOCK	7-09-82	2911.0	FTP	N/A	14.0618	0.1494	0.8410	290.96	0.5304	0.1465	N/A
STOCK CATALYST			3% O2										
815125	3	STOCK	7-30-82	2987.0	FTP	15.4	13.7517	0.1431	0.6034	297.79	1.9496	0.1360	0.587
STOCK CATALYST			0% O2	??									
815163+	0	STOCK	8-03-82	3006.0	FTP	27.1	14.0897	0.2623	0.8772	290.13	1.7836	0.2544	0.488
815208	0	STOCK	8-04-82	3018.0	FTP	26.3	14.7251	0.1587	0.6974	278.49	1.6792	N/A	0.303
NO CATALYST			0% O2										
815236+	0	NONE	8-10-82	3056.0	FTP	353.5	13.6099	1.0205	8.4539	285.83	2.1591	N/A	1.975
815238	0	NONE	8-11-82	3105.0	FTP	322.9	13.8083	0.8504	7.3019	284.24	2.1713	0.8498	1.783
815240	0	NONE	8-12-82	3144.4	FTP	313.8	13.6639	0.8728	7.3545	287.35	2.1717	0.8722	2.224
NO CATALYST			3% O2										
815248	3	NONE	8-18-82	3257.0	FTP	259.1	13.9984	0.7895	7.3910	280.21	2.0979	0.7885	2.135
815250	3	NONE	8-20-82	3286.0	FTP	281.3	13.9026	0.8525	7.2786	282.32	2.0922	0.8515	2.018
815254	3	NONE	8-24-82	3356.7	FTP	252.6	14.0144	0.7984	7.1572	280.38	2.1688	0.7984	2.093
NO CATALYST			5% O2										
815260	5	NONE	8-27-82	3453.7	FTP	185.0	13.9566	0.8024	7.2936	280.74	2.0884	N/A	N/A
815262	5	NONE	9-08-82	3492.0	FTP	189.1	13.8715	0.7675	7.2400	283.12	2.1144	N/A	2.413
815264	5	NONE	9-09-82	3541.7	FTP	197.8	13.4639	0.8304	7.7379	291.15	2.1911	N/A	2.442
4X6-12:1(#1)			0% O2										
815272	0	(#1)	9-15-82	3682.1	FTP	8.5	14.0052	0.1005	0.4165	293.47	0.7000	N/A	0.304
815990	0	(#1)	9-17-82	3768.1	FTP	13.2	13.8863	0.1095	0.7285	295.34	0.6666	0.1042	N/A
815992	0	(#1)	9-21-82	3807.0	FTP	13.2	14.0113	0.1222	0.9340	292.29	0.4967	0.1159	0.353
4X6-12:1(#1)			3% O2										
815995	3	(#1)	9-24-82	3861.9	FTP	17.5	14.5564	0.11310	0.3132	282.42	1.8790	0.1062	0.313
815997	3	(#1)	9-28-82	3901.5	FTP	12.9	13.6245	0.1281	0.5030	300.62	2.0981	0.1227	0.316
815999	3	(#1)	9-29-82	3940.0	FTP	16.4	13.8666	0.1149	0.3466	296.16	2.0414	0.1094	0.291
4X6-12:1(#1)			5% O2										
816003	5	(#1)	9-30-82	4003.5	FTP	18.9	13.7625	0.1280	0.4819	297.66	2.1175	0.1228	0.269
816006	5	(#1)	10-05-82	4105.0	FTP	20.9	13.8167	0.1229	0.3778	296.85	N/A	0.1179	0.318
816011	5	(#1)	10-06-82	4124.0	FTP	22.1	14.1075	0.1082	0.3230	290.77	N/A	0.1035	0.306
816014	5	(#1)	10-07-82	4183.4	FTP	22.0	13.9527	0.1383	0.4144	293.52	2.0731	0.1315	0.375
NO CATALYST			0% O2										
816020	0	NONE	10-13-82	4280.0	FTP	207.9	14.09	0.808	7.464	277.84	2.181	0.803	2.247
816022	0	NONE	10-14-82	4319.0	FTP	198.3	14.0943	0.7848	7.3961	277.63	2.2062	0.7804	2.453

```
     NO CATALYST         5% 02
816026   5 NONE       10-15-82   4373.7 FTP    205.0    13.9498 0.8364   7.9505 280.11   2.0682  0.8315    2.530

     6XRIO-12:1(#2)      0% 02
816564  0 (#2)        10-20-82   4464.0 FTP      9.9    14.0781 0.1117   0.7039 291.36   0.7672  N/A       N/A
816566  0 (#2)        10-29-82   4548.0 FTP     13.0    13.8257 0.1494   0.8403 296.29   0.7553  0.1444    0.820

     6XRIO-12:1(#2)      3% 02
816568  3 (#2)        11-02-82   4589.6 FTP     13.3    13.6716 0.1303   0.4661 299.66   2.0682  0.1262    N/A
816572  3 (#2)        11-03-82   4645.3 FTP     14.9    13.8274 0.1199   0.2350 296.99   2.0242  0.1153    N/A
816574  3 (#2)        11-04-82   4684.8 FTP     15.1    13.7135 0.1349   0.5085 298.58   2.0442  0.1299    N/A

     6XRIO-12:1(#2)      5% 02
816576  5 (#2)        11-05-82   4731.3 FTP     20.8    13.7635 0.1313   0.4592 298.39   2.0939  0.1262    N/A
816580+ 5 (#2)        11-18-82   4808.0 FTP     24.0    12.3230 0.1359   0.4268 333.39   1.0019  0.1290    0.286
816583+ 5 (#2)        11-19-82   4850.0 FTP     18.6    12.3214 0.1096   0.5138 333.07   1.0095  0.1015    0.154
816586+ 5 (#2)        11-24-82   4917.3 FTP     22.5    12.5241 0.1049   0.2558 328.10   1.0410  0.0962    N/A

     NO CATALYST         0% 02
816588+ 0 NONE        11-30-82   4956.6 FTP    192.6    12.5239 0.6484   7.4431 315.09   1.1407  0.6420    N/A
816589+ 0 NONE        12-01-82   4975.0 FTP    178.6    12.5321 0.6346   7.3333 314.96   1.1683  0.6288    1.725
816593+ 0 NONE        12-02-82   5040.0 FTP    202.7    12.7421 0.6111   7.7473 308.77   1.0961  0.6051    1.481
816595+ 0 NONE        12-03-82   5081.0 FTP    197.2    12.7486 0.6443   7.5822 308.98   1.1340  0.6390    1.940
816597  0 NONE        12-07-82   5123.5 FTP      N/A    13.3990 0.8553   7.3561 292.91   2.1846  N/A       N/A
816600  0 NONE        12-08-82   5156.0 FTP    209.6    14.0500 0.9118   7.7299 278.11   2.0816  0.9063    N/A

     4X6-3:2 (#3)        0% 02
816604  0 (#3)        12-09-82   5207.0 FTP     29.5    13.6483 0.1462   1.3991 299.37   0.8703  0.1424    N/A
816606  0 (#3)        12-10-82   5246.0 FTP      N/A    13.8791 0.1607   1.3575 294.13   0.8393  0.1549    N/A
816608  0 (#3)        12-14-82   5285.0 FTP      N/A    13.8121 0.1564   1.6463 294.90   0.8494  N/A       N/A

     4X6-3:2 (#3)        3% 02
816617  3 (#3)        12-17-82   5416.0 FTP      N/A    13.3648 0.1566   0.3553 307.12   2.0855  0.1507    0.212
816621  3 (#3)        12-21-82   5466.7 FTP     72.9    13.4959 0.1636   0.3453 304.36   2.0517  0.1562    0.340

     4X6-3:2 (#3)        5% 02
817462  5 (#3)        12-22-82   5520.0 FTP    117.4    13.5379 0.1810   0.3499 302.97   2.0929  N/A       0.296
817464  5 (#3)        12-23-82   5559.0 FTP    117.3    13.4848 0.1994   0.4406 303.84   1.9743  0.1930    0.423

     NO CATALYST         0% 02
817470  0 NONE         1-05-83   5627.5 FTP    131.60   13.5115 0.8626   8.2650 289.01   2.1324  N/A       N/A

     4X6-100PD(#4)       0% 02
817476  0 (#4)         1-07-83   5695.0 FTP     39.19   13.4461 0.1902   2.2857 301.62   0.7548  N/A       0.352
817478  0 (#4)         1-11-83   5734.8 FTP     38.55   13.5521 0.1636   2.0877 299.86   0.7479  0.1577    0.339
817480  0 (#4)         1-12-83   5773.0 FTP     46.90   13.4118 0.1533   1.5873 304.39   0.7261  0.1492    N/A

     4X6-100PD(#4)       3% 02
817484  3 (#4)         1-13-83   5834.0 FTP     76.65   13.4950 0.1514   0.3936 304.12   1.9570  0.1468    N/A
817488  3 (#4)         1-18-83   5931.0 FTP     59.33   13.3667 0.1384   0.3657 307.43   2.0082  0.1340    N/A
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   4X6-100PD(#4)      5% 02
817495  5 (#4)      1-19-83  5985.0 FTP   111.29   13.2414 0.1510  0.2864 310.47  2.0927  0.1453   N/A
817499  5 (#4)      1-20-82  6035.4 FTP   172.67   13.2268 0.1754  0.4578 309.96  2.1090  0.1701   N/A
817919  5 (#4)      1-25-83  6053.9 FTP   141.64   13.3241 0.1531  0.3253 308.29  1.9532  0.1482   N/A

   NO CATALYST        0% 02
817922  0 NONE      1-27-83  6104.3 FTP   325.72    N/A    0.9126  8.4891  N/A    2.0563  0.9081   N/A

   4X6-PDBM(#5)       0% 02
817925+ 0 (#5)      1-28-83  6135.3 FTP     N/A     N/A    0.2686  3.4711  N/A    1.9117  0.2645   N/A
817929+ 0 (#5)      2-01-83  6188.7 FTP     N/A     N/A    0.3128  3.7811  N/A    2.0131  0.3083   N/A

   4X6-PDBM(#5)       3% 02
817933+ 3 (#5)      2-02-83  6246.0 FTP     N/A    13.6595 0.2700  1.6259 298.38  1.9024  0.2656   N/A

   4X6-PDBM(#5)      ??% 02      (SUPPOSE TO HAVE BEEN 3%)
817937+ 9 (#5)      2-03-83  6302.0 FTP     N/A    13.6756 0.2951  1.9913 296.89  1.9255  0.2907   N/A

   4X6-PDBM(#5)       3% 02
817938+ 3 (#5)      2-04-83  6331.4 FTP    -1.0    13.76   0.2835  2.0466 294.88  2.0207  0.2782   N/A

   4X6-PDBM(#5)       0% 02
817939  0 (#5)      2-09-83  6393.5 FTP   118.46   14.1410 0.2767  2.7232 285.53  1.9502  0.2696   N/A
817943  0 (#5)      2-10-83  6444.8 FTP   119.24    N/A    0.2770  2.9788  N/A    1.9934  0.2704   N/A

   4X6-PDBM(#5)       3% 02
817947  3 (#5)      2-11-83  6501.3 FTP   117.52?   N/A    0.2749  1.9386  N/A    2.0035  0.2668   N/A
817951  3 (#5)      2-15-83  6555.5 FTP   141.23   13.8953 0.2811  2.1652 291.97  1.8986  0.2744   N/A

   4X6-PDBM(#5)       5% 02
817955  5 (#5)      2-16-83  6611.4 FTP   253.12   13.7489 0.3709  3.3620 293.02  1.9466  0.3622   N/A
817957  5 (#5)      2-17-83  6651.0 FTP   280.90   13.9140 0.3584  3.6692 289.27  1.9139  0.3520   N/A
818396  5 (#5)      2-18-83  6706.0 FTP   304.58   13.8929 0.3706  3.9338 289.16  1.9529  0.3640   N/A

   NO CATALYST        0% 02
818400  0 NONE      2-22-83  6759.8 FTP   232.07   13.8246 0.9258  7.5592 283.27  2.0131  0.9179   N/A
818402  9 NONE      2-23-83  6798.0 FTP   265.72   13.8391 0.9710  7.2660 282.68  1.9658  0.9646   N/A

   4X6-CU833(#6)      0% 02
818404  0 (#6)      2-24-83  6838.0 FTP   268.82   13.7239 0.9053  7.7205 285.38  1.8650  0.8970   N/A
818408  0 (#6)      2-25-83  6895.0 FTP   315.03   13.6627 0.9007  7.3105 286.85  1.9046  0.8932   N/A

   4X6-CU833(#6)      3% 02
818412  3 (#6)      3-01-83  6961.0 FTP   312.47   13.4330 0.9201  7.3714 291.51  1.8147  0.9138   N/A
818416  3 (#6)      3-02-83  7016.3 FTP   332.15   13.4489 0.8846  7.2143 291.94  1.8197  0.8784   N/A

   4X6-CU833(#6)      5% 02'
818648  5 (#6)      3-03-83  7073.1 FTP   303.13   13.5060 0.9055  6.9835 291.39  1.8135  0.8977   N/A
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818652	5 (#6)	3-04-83	7125.0 FTP	324.61	13.4351	0.8324	6.8828	293.39	1.8320	0.8256	N/A
NO CATALYST		0% O2									
818656	0 NONE	3-08-83	7178.3 FTP	219.54	14.0177	1.0565	7.2349	278.54	1.9660	1.0481	N/A
818658	0 NONE	3-09-83	7217.3 FTP	230.35	14.0640	1.0425	7.2773	277.80	1.9656	1.0342	N/A
4X6-20PD(#7)		0% O2									
818660	0 (#7)	3-10-83	7256.7 FTP	35.35	13.9155	0.1668	1.4919	292.75	0.6251	0.1621	N/A
818664	0 (#7)	3-11-83	7310.0 FTP	39.11	13.8335	0.1869	1.9312	294.40	0.6709	0.1781	N/A
818668	0 (#7)	3-15-83	7365.0 FTP	48.63	13.6820	0.2008	2.0945	296.69	0.7029	0.1934	N/A
4X6-20PD(#7)		3% O2									
818725	3 (#7)	3-16-83	7420.0 FTP	99.72	13.90	0.1598	0.3941	294.71	1.853	0.1526	N/A
818729	3 (#7)	3-17-83	7472.2 FTP	88.67	13.7657	0.1459	0.4040	297.97	1.9380	0.1403	N/A
4X6-20PD(#7)		5% O2									
818733+	5 (#7)	3-18-83	7530.0 FTP	115.28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
818737	5 (#7)	3-22-83	7579.7 FTP	102.16	13.77	0.1400	0.3263	298.28	1.908	N/A	N/A
818741	5 (#7)	3-23-83	7632.1 FTP	105.82	13.6385	0.12881	0.2993	301.38	1.9065	N/A	N/A
NO CATALYST		0% O2									
818978	0 NONE	3-24-83	7682.0 FTP	-1.0	14.0143	0.99998	7.3888	278.73	2.0565	N/A	N/A
818980	0 NONE	3-25-83	7722.0 FTP	N/A	14.1724	1.0123	7.1922	276.11	2.0132	N/A	N/A
NO CATALYST		3% O2									
818982	3 NONE	3-29-83	7765.0 FTP	N/A	14.0677	1.0679	7.1849	278.22	2.0030	N/A	N/A
818984	3 NONE	3-30-83	7804.0 FTP	N/A	13.6865	1.0762	7.2631	286.13	2.1006	N/A	N/A
NO CATALYST		5% O2									
818986	5 NONE	3-31-83	7845.0 FTP	N/A	13.9007	1.0617	7.5204	280.93	1.9903	N/A	N/A
818988	5 NONE	4-05-83	7892.0 FTP	N/A	13.8115	1.1244	7.3404	283.13	2.0798	1.1164	N/A
4X6-AG(#8)		0% O2									
818990	0 (#8)	4-07-83	7940.0 FTP	41.80	14.0376	0.4460	6.2919	281.64	2.0192	0.4399	N/A
818994	0 (#8)	4-08-83	7991.0 FTP	58.46	13.8416	0.6113	6.6857	284.78	2.0506	0.6032	N/A
819235	0 (#8)	4-13-83	8074.0 FTP	66.04	13.7650	0.54724	6.5997	286.98	2.0083	0.5400	N/A
819237	0 (#8)	4-15-83	8110.0 FTP	-1.0	13.7698	0.55378	6.5237	287.39	2.0347	0.5468	N/A
4X6-AG(#8)		3% O2									
819238	3 (#8)	4-19-83	8137.0 FTP	-1.0	13.6506	0.45320	5.8430	291.45	1.9848	0.4450	N/A
819240	3 (#8)	4-20-83	8185.0 FTP	-1.0	13.6009	0.35266	5.4735	292.53	2.0052	N/A	N/A
819245	3 (#8)	4-22-83	8275.0 FTP	-1.0	13.8767	0.47811	6.4773	284.98	1.9775	0.4713	N/A
4X6-AG(#8)		5% O2	???								
819249	5?(#8)	4-27-83	8356.0 FTP	-1.0	13.7857	0.54175	6.9620	285.50	1.8919	0.5346	N/A

NUMBER	O2	CAT#	DATE	ODOM	TPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814213	9	STOCK	6-29-82	2674.0	HWY	0.7	18.1264	0.0040	0.0807	227.30	0.1193	0.0007	0.003
814216	9	STOCK	6-30-82	2710.0	HWY	0.00	17.9689	0.0008	0.0834	229.10	0.1332	0.0012	0.007
814219	9	STOCK	7-01-82	2766.9	HWY	0.1	18.0390	0.0006	0.1507	227.83	0.0465	N/A	0.002
814222	9	STOCK	7-02-82	2823.1	HWY	0.1	18.2010	0.0012	0.1274	225.55	0.0683	0.0008	0.003
NO CATALYST			0% O2										
815237	0	NONE	8-10-82	3067.0	HWY	134.25	16.6392	0.4307	6.4057	236.38	3.0085	N/A	0.179
815239	0	NONE	8-11-82	3116.3	HWY	189.6	16.7268	0.4220	6.2377	235.01	3.0248	0.4215	0.831
815241	0	NONE	8-12-82	3155.4	HWY	193.0	17.0821	0.4139	6.1797	229.76	2.9135	0.4133	0.918
NO CATALYST			3% O2										
815249	3	NONE	8-18-82	3268.0	HWY	172.2	17.3098	0.3801	6.1442	226.71	2.9541	0.3798	0.888
815251	3	NONE	8-20-82	3307.0	HWY	171.7	17.4993	0.3623	5.8090	225.28	2.8343	0.3618	0.946
815255	3	NONE	8-24-82	3376.0	HWY	179.6	17.2819	0.3637	5.7837	228.35	2.8127	0.3637	0.948
NO CATALYST			5% O2										
815261	5	NONE	8-27-82	3475.0	HWY	140.6	17.4107	0.3549	5.9499	225.62	2.9286	N/A	N/A
815263	5	NONE	9-08-82	3524.0	HWY	139.5	17.4662	0.3343	6.1466	225.10	2.7814	N/A	0.883
815265	5	NONE	9-09-82	3572.0	HWY	139.7	17.0300	0.3514	6.1377	230.98	2.9443	N/A	0.795
4X6-12:1(#1)			0% O2										
815273	0	(#1)	9-15-82	3702.0	HWY	1.0	17.4390	0.0041	0.0540	235.59	0.6182	0.0038	0.012
815274	0	(#1)	9-16-82	3736.0	HWY	0.3	17.2951	0.0030	0.0269	238.21	0.6329	0.0027	0.006
815991	0	(#1)	9-17-82	3778.0	HWY	0.3	17.2193	0.0030	0.0640	239.04	0.5804	0.0030	N/A
4X6-12:1(#1)			3% O2										
815996	3	(#1)	9-24-82	3872.9	HWY	1.1	18.7124	0.0081	0.0	219.54	2.4257	0.0059	0.004
815998	3	(#1)	9-28-82	3912.5	HWY	1.0	17.0807	0.0094	0.0051	240.80	2.8921	0.0069	0.005
816000	3	(#1)	9-29-82	3951.0	HWY	1.6	17.4427	0.0084	0.0085	235.91	2.8837	0.0068	0.004
4X6-12:1(#1)			5% O2										
816004	5	(#1)	9-30-82	4020.5	HWY	2.2	17.2234	0.0097	0.0070	239.10	2.9207	0.0071	0.006
816012	5	(#1)	10-06-82	4134.0	HWY	1.9	17.4434	0.0098	0.0017	236.04	N/A	0.0070	0.005
816013	5	(#1)	10-06-82	4156.0	HWY	1.9	17.3703	0.0077	0.0	236.66	2.7212	0.0048	0.009
816015	5	(#1)	10-07-82	4213.5	HWY	1.7	17.5174	0.0114	0.0	234.86	2.7040	0.0080	0.004
NO CATALYST			0% O2										
816021	0	NONE	10-13-82	4300.0	HWY	164.6	17.3073	0.3859	6.1530	226.67	2.9362	0.3835	0.632
816023	0	NONE	10-14-82	4330.0	HWY	167.0	17.3474	0.3839	6.4405	226.24	2.9066	0.3813	0.904
NO CATALYST			5% O2										
816027	5	NONE	10-15-82	4384.0	HWY	147.0	17.5255	0.3927	6.1640	224.12	2.8608	0.3900	0.937
6XR10 12:1(#2)			0% O2										
816028	0	(#2)	10-19-82	4424.0	HWY	1.6	18.0459	0.0129	0.0671	228.40	0.4786	0.0126	0.065
816565	0	(#2)	10-20-82	?4484.0	HWY	1.1	17.9699	0.0070	0.0633	229.38	0.4752	N/A	N/A
816567	0	(#2)	10-29-82	4570.2	HWY	0.8	17.1471	0.0050	0.0572	239.52	0.6975	0.0046	0.004

6XRTO 12:1(#2)		3% O2										
816569	3 (#2)	11-02-82	4611.0	HWY	1.6	17.2948	0.0093	0.0234	237.75	2.8525	0.0080	0.010
816573	3 (#2)	11-03-82	4666.6	HWY	2.2	17.4416	0.0082	0.0241	236.36	2.8026	0.0072	0.009
816575	3 (#2)	11-04-82	4706.0	HWY	2.3	17.3666	0.0087	0.0276	237.38	2.8602	0.0073	0.023
6XRTO 12:1(#2)		5% O2										
816577	5 (#2)	11-05-82	4753.0	HWY	2.2	17.3664	0.0098	0.0282	237.17	2.7982	0.0083	0.027
816581*	5 (#2)	11-18-82	4816.0	HWY	1.4	15.4150	0.0089	0.0391	266.94	0.9135	0.0058	0.013
816584*	5 (#2)	11-19-82	4861.0	HWY	1.3	15.47	0.007	0.041	266.10	0.920	0.0045	0.010
816587*	5 (#2)	11-24-82	4938.6	HWY	1.2	15.7707	0.0061	0.0340	261.20	0.3223	0.0036	N/A
NO CATALYST		0% O2										
816590*	0 NONE	12-01-82	4986.0	HWY	79.6	15.3650	0.1127	6.1142	257.98	0.9980	0.1087	0.280
816591*	0 NONE	12-01-82	4998.0	HWY	86.4	15.4222	0.1099	6.1206	256.52	0.9859	0.1059	0.296
816594*	0 NONE	12-02-82	5061.0	HWY	95.9	15.5196	0.1183	6.3107	255.32	0.9713	0.1140	0.335
816596*	0 NONE	12-03-82	5102.0	HWY	91.1	15.3513	0.1237	6.2414	257.68	0.9981	0.1201	0.335
816601	0 NONE	12-08-82	5177.0	HWY	180.7	17.34	0.391	6.475	225.94	2.7854	0.388	N/A
4X6-3:2 (#3)		0% O2										
816605	0 (#3)	12-09-82	5239.0	HWY	0.91	16.9194	0.0090	0.1985	243.41	0.6462	0.0079	N/A
816607	0 (#3)	12-10-82	5268.0	HWY	N/A	17.2005	0.0061	0.2194	239.18	0.6255	0.0052	N/A
816609	0 (#3)	12-14-82	5296.0	HWY	N/A	17.3441	0.0069	0.2312	237.26	0.6478	N/A	N/A
4X6-3:2 (#3)		3% O2										
816614	3 (#3)	12-16-82	5387.0	HWY	N/A	16.8716	0.0099	0.0006	244.19	2.7580	0.0071	N/A
816618	3 (#3)	12-17-82	5438.0	HWY	N/A	16.8030	0.0095	0.0006	244.82	2.8118	0.0060	0.011
817459	3 (#3)	12-21-82	5488.0	HWY	1.7	17.0794	0.0100	0.0174	241.17	2.7388	0.0065	0.016
4X6-3:2 (#3)		5% O2										
817463	5 (#3)	12-22-82	5541.0	HWY	3.04	17.0110	0.0100	0.0005	242.24	2.8272	0.0065	0.009
817465	5 (#3)	12-23-82	5580.0	HWY	2.93	17.0807	0.0092	0.0078	241.45	2.7420	0.0060	0.009
NO CATALYST		0% O2										
817471	0 NONE	1-05-83	5635.0	HWY	69.13	17.0739	0.4087	6.9041	229.10	2.7800	N/A	N/A
4X6-100PD(#4)		0% O2										
817477	0 (#4)	1-07-83	5717.0	HWY	< 0.36	17.0440	0.0043	0.3455	241.29	0.5207	N/A	0.024
817479	0 (#4)	1-11-83	5745.0	HWY	1.10	16.9755	0.0058	0.3343	242.18	0.5736	0.0052	0.008
817481	0 (#4)	1-12-83	5795.0	HWY	0.71	16.9091	0.0064	0.2988	242.81	0.4281	0.0055	N/A
4X6 100PD(#4)		3% O2										
817485	3 (#4)	1-13-83	5855.0	HWY	1.67	17.0101	0.0090	0.0144	241.56	2.6469	0.0072	N/A
817489	3 (#4)	1-14-83	5902.0	HWY	1.90	17.0811	0.0073	0.0086	240.64	2.6516	0.0047	N/A
4X6 100PD(#4)		5% O2										
817492	5 (#4)	1-18-83	5955.0	HWY	2.65	17.0807	0.0086	0.0145	241.35	2.7267	0.0057	N/A
817496	5 (#4)	1-19-83	6007.0	HWY	2.80	16.9401	0.0094	0.0107	243.15	2.7164	0.0065	N/A
NO CATALYST		0% O2										
817921	0 NONE	1-26-83	6086.0	HWY	211.3	N/A	0.4329	7.0037	N/A	2.7261	0.4296	N/A

4X6-PDBM(#5)		0% 02											
817926+	0 (#5)	1 28 83	6156.0	HWY	N/A	N/A	0.0182	1.0911	N/A	1.2387	0.0152	N/A
817930+	0 (#5)	2 01 83	6210.0	HWY	N/A	N/A	0.0165	1.1313	N/A	1.5205	0.0136	N/A
4X6-PDBM(#5)		3% 02											
817934+	3 (#5)	2 02 83	6267.4	HWY	N/A	16.9395	0.0122	0.0118	242.57	2.5252	0.0096	N/A
4X6-PDBM(#5)		0% 02											
817940	0 (#5)	2 09 83	6417.0	HWY	2.64	17.5876	0.0166	1.3046	232.45	1.5459	0.0120	N/A
817944	0 (#5)	2 10 83	6466.0	HWY	3.59	N/A	0.0150	1.6607	N/A	1.7229	0.0110	N/A
4X6-PDBM(#5)		3% 02											
817948	3 (#5)	2 11 83	6512.4	HWY	2.76	N/A	0.0132	0.0306	N/A	2.5670	0.0093	N/A
817952	3 (#5)	2 15 83	6576.0	HWY	3.2	17.5099	0.0132	0.0608	234.96	2.6360	0.0092	N/A
4X6-PDBM(#5)		5% 02											
817958	5 (#5)	2 17 83	6672.0	HWY	11.48	17.5529	0.0133	0.3297	233.66	2.6455	0.0089	N/A
818397	5 (#5)	2-18 83	6727.0	HWY	17.46	17.8363	0.0146	0.5045	230.27	2.6354	0.0100	N/A
NO CATALYST		0% 02											
818401	0 NONE	2-22-83	6781.1	HWY	147.92	17.3571	0.4054	6.9511	225.13	2.8481	0.4007	N/A
818403	9 NONE	2-23-83	6819.0	HWY	215.12	17.5023	0.4203	6.9380	222.74	2.6737	0.4160	N/A
4X6-CU833(#6)		0% 02											
818405	0 (#6)	2 24 83	6859.0	HWY	136.31	17.3650	0.3463	6.9953	225.36	2.3906	0.3408	N/A
818409	0 (#6)	2-25-83	6917.0	HWY	125.11	16.6994	0.2617	6.8242	234.83	2.4293	0.2561	N/A
4X6-CU833(#6)		3% 02											
818413	3 (#6)	3-01-83	6987.0	HWY	137.98	17.0205	0.2053	6.5169	230.70	2.2578	0.1994	N/A
818645	3 (#6)	3 02-83	7037.5	HWY	136.34	16.9041	0.1941	6.3267	232.75	2.3029	0.1891	N/A
4X6-CU833(#6)		5% 02											
818649	5 (#6)	3-03-83	7094.3	HWY	127.17	16.9140	0.1690	6.2852	232.81	2.2086	0.1636	N/A
818653	5 (#6)	3 04 83	7146.2	HWY	121.33	16.5380	0.1308	6.0667	238.52	2.2044	0.1251	N/A
NO CATALYST		0% 02											
818657	0 NONE	3-08-83	7199.0	HWY	169.05	17.4239	0.4782	6.8550	223.59	2.5988	0.4727	N/A
818659	0 NONE	3 09 83	7238.0	HWY	177.73	17.4909	0.4878	6.9001	223.09	2.6669	0.4826	N/A
4X6-20PD(#7)		0% 02											
818661	0 (#7)	3 10 83	7278.0	HWY	1.99	17.2602	0.0109	0.3181	237.65	0.2972	0.0089	N/A
818665	0 (#7)	3 11 83	7331.0	HWY	1.87	17.3976	0.0083	0.3993	235.58	0.3231	0.0060	N/A
818669	0 (#7)	3 15 83	7386.0	HWY	N/A	17.1073	0.0084	0.4122	239.92	0.4224	0.0064	N/A
4X6-20PD(#7)		3% 02											
818726	3 (#7)	3 16 83	7442.0	HWY	2.93	17.0820	0.0080	-0.0038	240.70	2.5117	0.0052	N/A
818730	3 (#7)	3 17 83	7493.0	HWY	2.44	17.0103	0.0085	0.0109	241.73	2.5744	0.0054	N/A

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   4X6-2OPD(#7)        5% O2
818734  5 (#7)       3-18-83  7551.0 HWY     2.38    17.0820 0.0084   0.0038 241.03   2.5116  0.0051     N/A
818738  5 (#7)       3-22-83  7600.0 HWY     3.39    17.15   0.0079   0.0005 240.48   2.6069  N/A        N/A
818975  5 (#7)       3-23-83  7653.0 HWY     2.93    16.8714 0.01055  0.0041 244.45   2.7254   N/A       N/A

   NO CATALYST         0% O2
818979  0 NONE       3-24-83  7704.0 HWY    -1.0     16.9872 0.45717  6.9463 230.05   2.8408   N/A       N/A
818981  0 NONE       3-25-83  7743.0 HWY     N/A     17.2679 0.4763   6.9492 226.47   2.6875  N/A        N/A

   NO CATALYST         3% O2
818983  3 NONE       3-29-83  7787.0 HWY     N/A     17.5282 0.4592   6.6369 223.05   2.6645  N/A        N/A
818985  3 NONE       3-30-83  7826.0 HWY     N/A     17.0811 0.4706   6.7072 228.77   2.8010  N/A        N/A

   NO CATALYST         5% O2
818987  5 NONE       3-31-83  7867.0 HWY     N/A     17.2109 0.4793   6.8053 226.83   2.7454  N/A        N/A
818989  5 NONE       4-05-83  7914.0 HWY     N/A     17.1635 0.4764   6.5993 228.27   2.7699  0.4715     N/A

   4X6-AG(#8)          0% O2
818991  0 (#8)       4-07-83  7961.3 HWY     3.15    17.1595 0.0269   4.3635 232.73   2.7203  0.0222     N/A
818995  0 (#8)       4-08-83  8013.0 HWY     2.02    17.0239 0.02403  4.3117 235.15   2.7404  0.0195     N/A
818998  0 (#8)       4-12-83  8052.0 HWY     1.92    17.1198 0.02088  4.0922 233.77   2.7685  0.0159     N/A

   4X6-AG(#8)          3% O2
819239  3 (#8)       4-19-83  8158.0 HWY    -1.0     17.2059 0.02277  3.3188 233.57   2.6662  0.0179     N/A
819241  3 (#8)       4-20-83  8206.0 HWY    -1.0     16.9968 0.02032  3.2917 237.43   2.7236  0.0155     N/A
819242  3 (#8)       4-21-83  8240.0 HWY    -1.0     17.3945 0.01657  3.5916 230.54   2.6230  0.0118     N/A
819246  3 (#8)       4-22-83  8316.7 HWY    -1.0     17.5324 0.01629  3.6759 229.00   2.5562  0.0120     N/A

   4X6-AG(#8)          5% O2
819250  5?(#8)       4-27-83  8377.0 HWY    -1.0     17.5133 0.02381  5.1001 226.55   2.5913  0.0193     N/A
819251  5 (#8)       4-28-83  8405.3 HWY    -1.0     18.8888 0.02134  5.0321 210.37   2.2555  0.0162     N/A
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NUMBER	02	CAT#	DATE	ODOM	TPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814214	9	STOCK	6-29-82	2684.0	IDLE	0.00	122.0	0.0015	0.0029	33.840	0.0017	0.0008	0.0017
814217	9	STOCK	6-30-82	2733.4	IDLE	0.11	114.0	0.0020	0.0027	36.268	0.0000	0.0013	0.0021
814220	9	STOCK	7-01-82	2791.0	IDLE	0.10	119.0	0.0020	0.0053	34.746	0.0000	N/A	0.0007
814223	9	STOCK	7-02-82	2840.0	IDLE	0.13	124.0	0.0053	0.1084	33.125	0.0008	0.0041	0.0015
NO CATALYST			0% 02										
815242	0	NONE	8-13-82	3184.0	IDLE	19.97	119.0	0.0861	0.7157	33.094	0.0179	0.0858	0.2211
815244	0	NONE	8-17-82	3210.0	IDLE	19.80	128.0	0.0815	0.7258	30.643	0.0126	0.0818	0.1835
815246	0	NONE	8-17-82	3227.0	IDLE	20.58	124.0	0.0862	0.7344	32.107	0.0115	0.0859	0.1942
NO CATALYST			3% 02										
815252	3	NONE	8-20-82	3327.0	IDLE	23.55	128.0	0.0873	0.7497	30.513	0.0157	0.0871	0.2207
815257	3	NONE	8-25-82	3393.0	IDLE	15.91	143.0	0.0760	0.5881	27.610	0.0112	N/A	0.1909
815258	3	NONE	8-26-82	3419.0	IDLE	15.14	142.0	0.0734	0.5755	27.818	0.0112	N/A	0.2701
NO CATALYST			5% 02										
815266	5	NONE	9-10-82	3590.5	IDLE	20.16	121.0	0.0981	0.7702	32.639	0.0150	N/A	0.3064
815268	5	NONE	9-10-82	3612.7	IDLE	19.05	120.0	0.0999	0.7356	32.880	0.0139	N/A	0.2956
815270*	5	NONE	9-14-82	3652.0	IDLE	17.28	120.0	0.0768	0.7120	32.929	0.0134	N/A	0.2656
4X6-12:1(#1)			0% 02										
815275	0	(#1)	9-16-82	3737.4	IDLE	0.03	137.0	0.0011	0.00	30.121	0.0034	0.0001	0.0043
815993	0	(#1)	9-21-82	3818.3	IDLE	0.04	129.0	0.0045	0.00	31.840	0.0034	0.0029	0.0078
4X6-12:1(#1)			3% 02										
816001	3	(#1)	9-29-82	3971.8	IDLE	0.37	125.0	0.0022	0.0059	32.965	0.0146	0.0015	0.0014
4X6-12:1(#1)			5% 02										
816005	5	(#1)	9-30-82	4032.0	IDLE	0.75	122.0	0.0021	0.00	33.700	0.0151	0.0012	0.0021
816007	5	(#1)	10-01-82	4045.0	IDLE	0.84	114.0	0.0021	0.00	36.097	0.0081	0.0012	0.0022
816009	5	(#1)	10-01-82	4078.0	IDLE	1.33	130.0	0.0021	0.00	31.612	0.0099	0.0011	N/A
4X6-12:1(#1)			3% 02	(AGAIN)									
816016	3	(#1)	10-08-82	4228.3	IDLE	-1.0	133.0	0.0266	0.1719	30.577	0.0248	0.0254	0.0137
816018	3	(#1)	10-08-82	4233.2	IDLE	0.28	134.0	0.0034	0.0028	30.787	0.0128	0.0028	0.0149
NO CATALYST			0% 02										
816024	0	NONE	10-14-82	4351.0	IDLE	10.02	146.0	0.0878	0.6021	26.964	0.0196	0.0874	0.2467
6XR10-12:1(#2)			0% 02										
816029	0	(#2)	10-19-82	4444.0	IDLE	0.45	146.0	0.0030	0.00	28.273	0.0053	0.0024	0.0126
816570	0	(#2)	11-02-82	4623.2	IDLE	1.34	134.0	0.0020	0.00	30.639	0.0169	0.0013	N/A
6XR10-12:1(#2)			5% 02										
816578	5	(#2)	11-05-82	4765.0	IDLE	1.52	119.0	0.0037	0.0056	34.498	0.0231	0.0030	0.0069
816582*	5	(#2)	11-18-82	4820.0	IDLE	N/A	113.0	0.0034	0.0003	36.453	0.0115	0.0026	0.0060

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   NO CAT CHECK OUT    5% 02
816585+ 5 NONE      11-19-82   4888.0 IDLE     0.94   123.0    0.0868  0.6445  32.148 0.0240  0.0856    N/A

   NO CATALYST          0% 02
816592+ 0 NONE      12-01-82   5027.0 IDLE    19.96   137.0    0.0941  0.5186  28.956 0.0258  0.0937   0.2956
816598  0 NONE      12-07-82   5137.0 IDLE    13.46   136.0    0.1117  0.6316  28.825 0.0290  0.1113    N/A
816602  0 NONE      12-08-82   5188.0 IDLE    12.45   142.0    0.0882  0.6407  27.786 0.0332  0.0870    N/A

   4X6-3:2 (#3)         0% 02
816610  0 (#3)      12-14-82   5319.0 IDLE     N/A    134.0    0.0027  0.0027  30.789 0.0093    N/A      N/A
816612  0 (#3)      12-15-82   5338.0 IDLE     N/A    132.0    0.0047  0.0003  31.289 0.0052  0.0041    N/A

   4X6-3:2 (#3)         3% 02
816615  3 (#3)      12-16-82   5400.0 IDLE     N/A    115.0    0.0058  0.0001  35.781 0.0237  0.0051    N/A
816619  3 (#3)      12-17-82   5448.0 IDLE     N/A    112.0    0.0715  0.2712  36.091 0.0329  0.0708    N/A
817460  3 (#3)      12-21-82   5499.0 IDLE    10.38   124.0    0.0192  0.0560  33.116 0.0246  0.0183   0.0342

   4X6-3:2 (#3)         5% 02
817466  5 (#3)       1-04-83   5598.6 IDLE    49.64   111.0    0.0359  0.0029  36.884 0.0141    N/A      N/A
817468  5 (#3)       1-04-83   5609.0 IDLE    56.26   121.0    0.0709  0.0056  33.710 0.0188    N/A      N/A

   NO CATALYST          0% 02
817472  0 NONE       1-05-83   5662.0 IDLE     6.98   109.0    0.1591  0.8313  36.002 0.0456    N/A      N/A

   4X6-100PD(#4)        0% 02
817474  9 (#4)       1-06-83   5674.0 IDLE    14.16   119.0    0.1371  0.4931  33.535 0.0240    N/A     0.4315
817482  0 (#4)       1-12-83   5805.0 IDLE   < 0.45   121.0    0.0024  0.0029  33.894 0.0041  0.0017    N/A

   4X6-100PD(#4)        3% 02
817486  3 (#4)       1-13-83   5865.0 IDLE     4.04   123.0    0.0044  0.0001  33.394 0.0108  0.0038    N/A
817490  3 (#4)       1-14-83   5912.0 IDLE    11.16   124.0    0.0081  0.0031  33.179 0.0123  0.0066    N/A

   4X6-100PD(#4)        5% 02
817493  5 (#4)       1-18-83   5966.6 IDLE    26.82   121.0    0.0098  0.0084  34.051 0.0082  0.0086    N/A
817497  5 (#4)       1-19-83   6017.0 IDLE    29.11   116.0    0.0164  0.0026  35.412 0.0224  0.0149    N/A

   4X6-100PD(#4)        0% 02    AGAIN
817920  0 (#4)       1-25-83   6066.0 IDLE    11.59   119.0    0.0139  0.0029  34.632 0.0084  0.0130    N/A

   NO CATALYST          0% 02
817923  0 NONE       1-27-83   6116.0 IDLE    24.12    N/A     0.1133  1.047    N/A   0.0242  0.1122    N/A

   4X6-PDBM(#5)         0% 02
817927+ 0 (#5)       1-28-83   6168.0 IDLE     N/A     N/A     0.0724  0.4728    N/A  0.0211  0.0716    N/A
817931+ 0 (#5)       2-01-83   6222.0 IDLE     N/A     N/A     0.1084  0.5110    N/A  0.0259  0.1073    N/A

   4X6 PDBM(#5)         3% 02
817935+ 3 (#5)       2-02-83   6277.0 IDLE     N/A    132.0    0.0997  0.6692  29.871 0.0299  0.0986    N/A
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4X6-PDBM(#5)		0% 02										
817941	0 (#5)	2-09-83	6425.0	IDLE	13.24	136.0	0.0805	0.3648	29.361	0.0244	0.0795	N/A
817945	0 (#5)	2-10-83	6477.0	IDLE	13.38	N/A	0.0897	0.4169	N/A	0.0231	0.0889	N/A
4X6-PDBM(#5)		3% 02										
817949	3 (#5)	2-11-83	6533.0	IDLE	-1.0	N/A	0.0999	0.4517	N/A	0.0244	0.0982	N/A
817953	3 (#5)	2-15-83	6587.0	IDLE	-1.0	128.0	0.1222	0.4059	31.261	0.0299	0.1218	N/A
4X6-PDBM(#5)		5% 02										
818394	5 (#5)	2-17-83	6685.0	IDLE	N/A	118.0	0.1337	0.6420	33.424	0.0456	0.1318	N/A
818398	5 (#5)	2-18-83	6741.0	IDLE	N/A	123.0	0.1365	0.6009	32.014	0.0431	0.1353	N/A
4X6-CU833(#6)		0% 02										
818406	0 (#6)	2-24-83	6871.0	IDLE	N/A	127.0	0.1473	0.5354	31.234	0.0329	0.1458	N/A
818410	0 (#6)	2-25-83	6927.2	IDLE	N/A	124.0	0.1436	0.6254	31.716	0.0262	0.1421	N/A
4X6-CU833(#6)		3% 02										
818414	3 (#6)	3-01-63	6997.0	IDLE	N/A	118.0	0.1611	0.5907	33.317	0.0264	0.1604	N/A
818646	3 (#6)	3-02-83	7047.7	IDLE	N/A	121.0	0.1401	0.8202	32.273	0.0279	0.1391	N/A
4X6-CU833(#6)		5% 02										
818650	5 (#6)	3-03-83	7104.6	IDLE	N/A	112.0	0.1566	0.6746	35.190	0.0302	0.1547	N/A
818654	5 (#6)	3-04-83	7156.0	IDLE	N/A	118.0	0.1705	0.5711	33.575	0.0296	0.1698	N/A
4X6-2OPD(#7)		0% 02										
818662	0 (#7)	3-10-83	7288.7	IDLE	N/A	124.0	0.0272	0.2243	32.690	0.0066	0.0260	N/A
818666	0 (#7)	3-11-83	7345.0	IDLE	N/A	109.0	0.0766	0.1233	37.319	0.0127	0.0750	N/A
818723	0 (#7)	3-15-83	7396.0	IDLE	N/A	127.0	0.0015	0.0677	32.199	0.0008	0.0005	N/A
4X6-2OPD(#7)		3% 02										
818727	3 (#7)	3-16-83	7452.0	IDLE	N/A	124.0	0.0116	0.0023	33.168	0.0155	0.0109	N/A
818731	3 (#7)	3-17-83	7504.0	IDLE	N/A	126.0	0.0075	0.0083	32.526	0.0229	0.0063	N/A
4X6-2OPD(#7)		5% 02										
818735	5 (#7)	3-18-83	7561.0	IDLE	-1.0	123.0	0.0233	0.0028	33.275	0.0243	0.0219	N/A
818739	5 (#7)	3-22-83	7611.0	IDLE	-1.0	123.0	0.0207	0.0055	33.326	0.0235	N/A	N/A
818976	5 (#7)	3-23-83	7663.0	IDLE	-1.0	119.0	0.0287	0.0001	34.4820	0.0271	N/A	N/A
4X6-AG(#8)		0% 02										
818992	0 (#8)	4-07-83	7971.0	IDLE	N/A	132.0	0.0663	0.4556	30.292	0.0198	0.0655	N/A
818996	0 (#8)	4-08-83	8023.0	IDLE	-1.0	123.0	0.0415	0.4889	32.6374	0.0187	0.0402	N/A
4X6 AG(#8)		3% 02										
819243	3 (#8)	4-21-83	8254.0	IDLE	-1.0	104.0	0.1259	0.8400	37.7738	0.0241	0.1241	N/A
819247	3 (#8)	4-22-83	8326.8	IDLE	-1.0	122.0	0.0538	0.7222	32.4326	0.0164	0.0523	N/A

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NUMBER 02  CAT#      DATE      ODOM   TPRO   ALDY     MPG     HC       CO      CO2      NOX   HC-NM    METHANOL

   4X6-12:1(#1)      0% 02
816032  0 (#1)     9-16-82   3747.0 SS10    1.9     10.0    0.028    0.0     412.091 0.010  0.026     0.060
815993  0 (#1)     9-21-82   3818.3 SS10    0.2     10.1    0.012    0.0     407.333 0.045  0.002     0.008

   4X6-12:1(#1)      3% 02
816001  3 (#1)     9-29-82   3971.8 SS10    1.3     10.1    0.022    0.016   407.998 0.284  0.009     0.007

   4X6-12:1(#1)      5% 02
816005  5 (#1)     9-30-82   4032.0 SS10    1.8     10.1    0.019    0.016   406.680 0.331  0.007     0.007
816007  5 (#1)    10-01-82   4045.0 SS10    3.7      9.6    0.025    0.0     430.273 0.295  0.012     0.013
816009  5 (#1)    10-01-82   4078.0 SS10    5.8     10.1    0.025    0.0     406.958 0.302  0.012     N/A

   4X6-12:1(#1)      3% 02   (AGAIN)
816016  3 (#1)    10-08-82   4228.3 SS10    4.7     10.3    0.038    0.034   382.462 0.301  0.025     0.006
816018  3 (#1)    10-08-82   4233.2 SS10   11.7     10.4    0.024    0.033   394.687 0.285  0.013     0.009

   NO CATALYST       0% 02
816024  0 NONE    10-14-82   4351.0 SS10  109.2     10.2    0.427   11.387   382.462 0.261  0.415     1.046

   6XR10-12:1(#2)    0% 02
816029  0 (#2)    10-19-82   4444.0 SS10    0.2     10.5    0.020    0.0     391.840 0.196  0.010     0.161
816570  0 (#2)    11-02-82   4623.2 SS10    2.0     10.2    0.021    0.0     402.966 0.267  0.011     N/A

   6XR10-12:1(#2)    5% 02
816578  5 (#2)    11-05-82   4765.0 SS10    1.8     10.0    0.023    0.018   413.033 0.304  0.014     0.022
816582+ 5 (#2)    11-18-82   4820.0 SS10    2.7      9.5    0.027    0.020   433.838 0.290  0.014     0.011

   NO CATALYST       0% 02
816592+ 0 NONE    12-01-82   5027.0 SS10  133.4      9.6    0.412    8.879   415.744 0.331  0.401     1.174
816598  0 NONE    12-07-82   5137.0 SS10  151.2      9.9    0.396    9.706   397.574 0.330  0.387     N/A
816602  0 NONE    12-08-82   5188.0 SS10  129.4     10.0    0.433   10.408   394.668 0.335  0.419     N/A

   4X6-3:2 (#3)      0% 02
816610  0 (#3)    12-14-82   5319.0 SS10    N/A     10.2    0.022    0.235   404.822 0.045  N/A       N/A
816612  0 (#3)    12-15-82   5338.0 SS10    N/A      9.8    0.040    0.154   418.207 0.041  0.030     N/A

   4X6-3:2 (#3)      3% 02
816615  3 (#3)    12-16-82   5400.0 SS10    N/A      9.7    0.025    0.001   424.816 0.279  0.013     N/A
816619  3 (#3)    12-17-82   5448.0 SS10    N/A      9.6    0.090    0.222   429.683 0.339  0.075     N/A
817460  3 (#3)    12-21-82   5499.0 SS10   64.80     9.8    0.038    0.0     421.589 0.308  0.023     0.036

   4X6-3:2 (#3)      5% 02
817466  5 (#3)     1-04-83   5598.6 SS10  293.06     9.8    0.102    0.001   421.831 0.258  N/A       N/A
??????  5 (#3)     1-04-83   \\\\.\ SS10  294.49    -1.0   -1.0     -1.0      -1.0  -1.0   -1.0

   NO CATALYST       0% 02
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817472  O NONE      1-05-83  5662.0 SS10  106.85    9.9    0.528  10.429  396.796 0.365   N/A      N/A

   4X6-100PD(#4)      0% 02
817474  9 (#4)      1-06-83  5674.0 SS10   41.53    9.8    0.176   3.459  415.500 0.041   N/A      0.517
817482  0 (#4)      1-12-83  5805.0 SS10  < 2.13    9.8    0.033   1.644  417.695 0.005   0.020    N/A

   4X6-100PD(#4)      3% 02
817486  3 (#4)      1-13-83  5865.0 SS10   28.4     9.7    0.043   0.002  422.212 0.263   0.027    N/A
817490  3 (#4)      1-14-83  5912.0 SS10   44.0    10.2    0.043   0.036  403.611 0.243   0.025    N/A

   4X6-100PD(#4)      5% 02
817493  5 (#4)      1-18-83  5966.6 SS10   81.2     9.7    0.036   0.003  426.404 0.237   0.018    N/A
817497  5 (#4)      1-19-83  6017.0 SS10  134.5     9.6    0.061   0.021  428.430 0.260   0.046    N/A

   4X6-100PD(#4)      0% 02  AGAIN
817920  0 (#4)      1-25-83  6066.0 SS10   35.05    9.7    0.103   3.569  417.534 0.030   0.090    N/A

   NO CATALYST        0% 02
817923  O NONE      1-27-83  6116.0 SS10  226.62   N/A     0.602  13.445    N/A   0.300   0.591    N/A

   4X6-PDBM(#5)       0% 02
817927+ 0 (#5)      1-28-83  6168.0 SS10   N/A     N/A     0.392   8.070    N/A   0.282   0.381    N/A
817931+ 0 (#5)      2-01-83  6222.0 SS10   N/A     N/A     0.485   8.279    N/A   0.285   0.475    N/A

   4X6-PDBM(#5)       3% 02
817935+ 3 (#5)      2-02-83  6277.0 SS10   N/A    10.1     0.372   8.784  392.571 0.293   0.362    N/A

   4X6 PDBM(#5)       0% 02
817941  0 (#5)      2-09-83  6425.0 SS10   69.3   10.3     0.303   5.398  390.249 0.286   0.292    N/A
817945  0 (#5)      2-10-83  6477.0 SS10   82.05   N/A     0.261   4.916    N/A   0.296   0.249    N/A

   4X6-PDBM(#5)       3% 02
817949  3 (#5)      2-11-83  6533.0 SS10   -1.0    N/A     0.287   5.018   -1.0   0.286   0.271    N/A
817953  3 (#5)      2-15-83  6587.0 SS10   -1.0   10.1     0.376   5.286  398.10  0.323   0.362    N/A

   4X6-PDBM(#5)       5% 02
818394  5 (#5)      2-17-83  6685.0 SS10   N/A     9.9     0.549   9.753  398.331 0.341   0.534    N/A
818398  5 (#5)      2-18-83  6741.0 SS10   N/A    10.1     0.531   8.405  394.560 0.329   0.517    N/A

   4X6-CU833(#6)      0% 02
818406  0 (#6)      2-24-83  6871.0 SS10   N/A    10.1     0.671   7.989  391.295 0.308   0.656    N/A
818410  0 (#6)      2-25-83  6927.2 SS10   N/A    10.1     0.628   7.625  393.257 0.305   0.615    N/A

   4X6 CU833(#6)      3% 02
818414  3 (#6)      3-01-83  6997.0 SS10   N/A    10.0     0.575   7.676  397.248 0.301   0.565    N/A
818646  3 (#6)      3-02-83  7047.7 SS10   N/A    10.1     0.543   8.652  393.277 0.293   0.530    N/A
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   4X6-CU833(#6)     5% 02
818650  5 (#6)     3-03-83  7104.6 SS10    N/A     9.9    0.608   8.084  401.134 0.307   0.593     N/A
818654  5 (#6)     3-04-83  7156.0 SS10    N/A    10.1    0.677   8.208  394.334 0.322   0.665     N/A

   4X6-20PD(#7)      0% 02
818662  0 (#7)     3-10-83  7288.7 SS10    N/A    10.1    0.200   2.014  402.210 0.045   0.187     N/A
818666  0 (#7)     3-11-83  7345.0 SS10    N/A    10.1    0.265   2.429  402.880 0.046   0.249     N/A
818723  0 (#7)     3-15-83  7396.0 SS10    N/A    10.1    0.039   2.213  403.175 0.010   0.023     N/A

   4X6-20PD(#7)      3% 02
818727  3 (#7)     3-16-83  7452.0 SS10    N/A    10.0    0.074   0.021  413.021 0.279   0.058     N/A
818731  3 (#7)     3-17-83  7504.0 SS10    N/A    10.1    0.071   0.035  407.281 0.281   0.058     N/A

   4X6-20PD(#7)      5% 02
818735  5 (#7)     3-18-83  7561.0 SS10   -1.0    10.1    0.112   0.066  405.92  0.271   0.0963    N/A
818739  5 (#7)     3-22-83  7611.0 SS10   -1.0    10.1    0.109   0.018  405.27  0.276     N/A     N/A
818976  5 (#7)     3-23-83  7663.0 SS10   -1.0     9.9    0.106   0.051 414.168  0.275    N/A      N/A

   4X6-AG(#8)        0% 02
818992  0 (#8)     4-07-83  7971.0 SS10    N/A    10.2    0.290   6.839  391.652 0.298   0.280     N/A
818996  0 (#8)     4-08-83  8023.0 SS10   -1.0     9.9    0.197   6.491 403.087  0.292   0.1838    N/A

   4X6-AG(#8)        3% 02
819243  3 (#8)     4-21-83  8254.0 SS10   -1.0     9.8    0.548   9.261 401.849  0.367   0.5347    N/A
819247  3 (#8)     4-22-83  8326.8 SS10   -1.0    10.1    0.216   9.601 390.667  0.251   0.2160    N/A
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NUMBER	O2	CAT#	DATE	ODOM	TPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814214	9	STOCK	6-29-82	2684.0	SS20	0.2	19.8	0.005	0.017	207.976	0.005	0.001	0.003
814217	9	STOCK	6-30-82	2733.4	SS20	0.3	19.4	0.005	0.016	211.969	0.002	0.001	0.005
814220	9	STOCK	7-01-82	2791.0	SS20	0.2	18.9	0.008	0.016	217.309	0.0	N/A	0.001
814223	9	STOCK	7-02-82	2840.0	SS20	0.2	19.4	0.010	0.150	211.960	0.0	0.005	0.002
NO CATALYST			0% O2										
815242	0	NONE	8-13-82	3184.0	SS20	158.8	19.3	0.396	4.549	205.257	0.476	0.393	1.219
815244	0	NONE	8-17-82	3210.0	SS20	163.1	19.2	0.387	4.303	206.141	0.531	0.386	0.873
815246	0	NONE	8-17-82	3227.0	SS20	164.5	19.2	0.377	4.255	206.385	0.479	0.376	0.854
NO CATALYST			3% O2										
815252	3	NONE	8-20-82	3327.0	SS20	151.2	19.9	0.334	4.312	198.650	0.442	0.332	0.826
815257	3	NONE	8-25-82	3393.0	SS20	133.8	19.4	0.348	4.053	204.728	0.496	N/A	1.012
815258	3	NONE	8-26-82	3419.0	SS20	84.8	19.6	0.334	3.813	203.511	0.473	N/A	1.298
NO CATALYST			5% O2										
815266	5	NONE	9-10-82	3590.5	SS20	105.9	18.9	0.344	4.425	209.483	0.437	N/A	1.298
815268	5	NONE	9-10-82	3612.7	SS20	104.2	19.1	0.326	4.307	207.280	0.427	N/A	1.084
815270+	5	NONE	9-14-82	3652.0	SS20	127.9	19.4	0.324	4.203	204.531	0.392	N/A	1.115
4X6-12:1(#1)			0% O2										
816032	0	(#1)	9-16-82	3747.0	SS20	0.7	19.6	0.005	0.008	209.625	0.008	0.004	0.022
815994	0	(#1)	9-21-82	3828.0	SS20	2.2	19.8	0.011	0.025	207.955	0.053	0.009	0.016
4X6-12:1(#1)			3% O2										
816002	3	(#1)	9-29-82	3983.0	SS20	1.0	19.4	0.010	0.0	211.833	0.413	0.006	0.004
4X6-12:1(#1)			5% O2										
816008	5	(#1)	10-01-82	4065.0	SS20	1.1	19.4	0.008	0.0	212.446	0.492	0.004	0.002
816010	5	(#1)	10-01-82	4100.0	SS20	1.6	19.4	0.007	0.0	212.181	0.448	0.004	N/A
4X6-12:1(#1)			3% O2	(AGAIN)									
816017	3	(#1)	10-08-82	4229.9	SS20	N/A	19.8	0.011	0.001	208.343	0.480	0.005	0.005
816019	3	(#1)	10-08-82	4236.5	SS20	2.6	19.5	0.039	0.279	210.177	0.540	0.034	0.036
NO CATALYST			0% O2										
816025	0	NONE	10-14-82	4353.0	SS20	97.2	19.5	0.381	4.211	203.749	0.579	0.378	0.977
6XRTO-12:1(#2)			0% O2										
816563	0	(#2)	10-19-82	4450.0	SS20	0.8	20.3	0.008	0.0	202.953	0.133	0.005	0.039
816571	0	(#2)	11-02-82	4625.0	SS20	1.5	19.6	0.010	0.0	210.063	0.413	0.007	N/A
6XRTO-12:1(#2)			5% O2										
816579	5	(#2)	11-05-82	4768.0	SS20	1.5	19.4	0.010	0.009	212.475	0.471	0.007	0.101
816582+	5	(#2)	11-18-82	4820.0	SS20	N/A	17.0	0.011	0.019	242.229	0.340	0.004	0.023

NO CAT CHECK OUT		5% 02										
816585+	5 NONE	11-19-82	4888.0	SS20	2.17	16.2	0.256	4.480	245.691	0.356	0.251	N/A
NO CATALYST		0% 02										
816599	0 NONE	12-07-82	5140.0	SS20	98.61	19.5	0.343	4.582	203.264	0.493	0.338	N/A
816603	0 NONE	12-08-82	5192.0	SS20	94.27	19.1	0.399	4.762	206.711	0.521	0.395	N/A
4X6-3:2 (#3)		0% 02										
816611	0 (#3)	12-14-82	5321.0	SS20	N/A	18.9	0.030	0.451	216.899	0.056	N/A	N/A
816613	0 (#3)	12-15-82	5343.0	SS20	N/A	19.0	0.011	0.604	216.275	0.051	0.007	N/A
4X6-3:2 (#3)		3% 02										
816616	3 (#3)	12-16-82	5403.0	SS20	N/A	18.8	0.012	0.0	219.108	0.430	0.008	N/A
816620	3 (#3)	12-17-82	5454.0	SS20	N/A	18.4	0.029	-0.015	223.884	0.538	0.023	0.055
817461	3 (#3)	12-21-82	5504.0	SS20	70.58	19.2	0.018	0.0	214.202	0.477	0.012	0.047
4X6-3:2 (#3)		5% 02										
817467	5 (#3)	1-04-83	5599.6	SS20	165.52	19.1	0.097	0.009	215.616	0.423	N/A	N/A
817469	5 (#3)	1-04-83	5612.0	SS20	144.94	17.7	0.174	0.309	231.697	0.380	N/A	N/A
NO CATALYST		0% 02										
817473	0 NONE	1-05-83	5668.0	SS20	73.74	21.1	0.409	5.024	185.760	0.475	N/A	N/A
4X6-100PD(#4)		0% 02										
817475	0 (#4)	1-06-83	5680.0	SS20	19.83	17.9	0.120	1.276	227.161	0.052	N/A	0.322
817483	0 (#4)	1-12-83	5808.0	SS20	20.8	18.1	0.134	1.615	224.514	0.037	0.128	N/A
4X6-100PD(#4)		3% 02										
817487	3 (#4)	1-13-83	5869.0	SS20	113.6	18.9	0.055	0.009	217.800	0.389	0.051	N/A
817491	3 (#4)	1-14-83	5921.0	SS20	91.5	18.5	0.039	0.018	221.824	0.459	0.034	N/A
4X6-100PD(#4)		5% 02										
817494	5 (#4)	1-18-83	5968.4	SS20	138.9	18.6	0.039	0.018	221.602	0.374	0.032	N/A
817498+	5 (#4)	1-19-83	6020.0	SS20	108.5	17.2	0.171	0.069	239.240	0.668	0.166	N/A
NO CATALYST		0% 02										
817924	0 NONE	1-27-83	6118.0	SS20	165.45	N/A	0.477	6.459	N/A	0.489	0.472	N/A
4X6-PDBM(#5)		0% 02										
817928+	0 (#5)	1-28-83	6172.0	SS20	N/A	N/A	0.222	4.255	N/A	0.417	0.218	N/A
817932+	0 (#5)	2-01-83	6225.0	SS20	N/A	N/A	0.347	4.759	N/A	0.457	0.344	N/A
4X6-PDBM(#5)		3% 02										
817936+	3 (#5)	2-02-83	6282.0	SS20	N/A	18.8	0.346	4.977	210.618	0.532	0.341	N/A
4X6-PDBM(#5)		0% 02										
817942	0 (#5)	2-09-83	6428.0	SS20	61.38	19.5	0.295	3.095	204.865	0.452	0.292	N/A
817946+	0 (#5)	2-10-83	6481.0	SS20	5.11	N/A	0.363	3.404	-1.0	0.519	0.359	N/A

4X6 PDBM(#5)		3% 02										
817950	3 (#5)	2-11-83	6535.0	SS20	N/A	N/A	0.394	3.453	-1.0	0.403	0.389	N/A
817954	3 (#5)	2-15-83	6591.0	SS20	N/A	18.9	0.428	4.171	210.091	0.528	0.422	N/A
4X6-PDBM(#5)		5% 02										
818395	5 (#5)	2-17-83	6688.0	SS20	N/A	18.4	0.461	4.476	215.243	0.445	0.455	N/A
818399	5 (#5)	2-18-83	6743.0	SS20	N/A	19.7	0.410	4.117	201.220	0.409	0.404	N/A
4X6-CU833(#6)		0% 02										
818407	0 (#6)	2-24-83	6874.0	SS20	N/A	19.3	0.545	4.226	205.099	0.515	0.538	N/A
818411	0 (#6)	2-25-83	6930.0	SS20	N/A	18.7	0.596	4.197	211.748	0.507	0.590	N/A
4X6-CU833(#6)		3% 02										
818415	3 (#6)	3-01-83	7000.0	SS20	N/A	19.1	0.500	3.665	208.055	0.478	0.494	N/A
818647	3 (#6)	3-02-83	7053.2	SS20	N/A	18.8	0.542	4.453	209.772	0.550	0.538	N/A
4X6-CU833(#6)		5% 02										
818651	5 (#6)	3-03-83	7108.8	SS20	N/A	19.1	0.470	3.662	208.633	0.488	0.465	N/A
818655	5 (#6)	3-04-83	7159.1	SS20	N/A	19.4	0.444	3.808	204.615	0.420	0.439	N/A
4X6-20PD(#7)		0% 02										
818663	0 (#7)	3-10-83	7294.7	SS20	N/A	19.4	0.062	0.925	210.324	0.025	0.057	N/A
818667	0 (#7)	3-11-83	7348.0	SS20	N/A	18.9	0.168	0.426	216.848	0.124	0.162	N/A
818724	0 (#7)	3-15-83	7399.0	SS20	N/A	19.0	0.032	1.211	214.841	0.023	0.026	N/A
4X6-20PD(#7)		3% 02										
818728	3 (#7)	3-16-83	7454.0	SS20	N/A	19.4	0.118	0.058	211.523	0.384	0.112	N/A
818732	3 (#7)	3-17-83	7506.0	SS20	N/A	18.9	0.074	0.018	217.605	0.348	0.070	N/A
4X6-20PD(#7)		5% 02										
818736	5 (#7)	3-18-83	7563.0	SS20	-1.0	19.6	0.128	0.009	209.43	0.368	0.123	N/A
818740	5 (#7)	3-22-83	7614.0	SS20	-1.0	19.3	0.036	0.008	212.70	0.410	N/A	N/A
818977	5 (#7)	3-23-83	7666.0	SS20	-1.0	19.0	0.091	0.001	216.139	0.442	N/A	N/A
4X6-AG(#8)		0% 02										
818993	0 (#8)	4-07-83	7974.8	SS20	N/A	19.5	0.323	3.424	205.155	0.426	0.319	N/A
818997	0 (#8)	4-08-83	8026.0	SS20	-1.0	18.4	0.285	3.401	217.318	0.426	0.2797	N/A
4X6-AG(#8)		3% 02										
819244	3 (#8)	4-21-83	8259.0	SS20	-1.0	19.4	0.198	4.199	205.312	0.317	0.1914	N/A
819248	3 (#8)	4-22-83	8392.0	SS20	-1.0	18.8	0.309	4.319	211.220	0.334	N/A	N/A

NUMBER	O2	CAT#	DATE	ODOM	TPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814215	9	STOCK	6-29-82	2685.0	SS30	1.4	21.7	0.004	0.062	189.231	0.002	0.005	0.009
814218	9	STOCK	6-30-82	2739.4	SS30	0.4	21.7	0.005	0.057	189.665	0.0	0.002	0.003
814221	9	STOCK	7-01-82	2810.0	SS30	2.4	20.9	0.006	0.069	197.007	0.007	0.004	0.009
814224	9	STOCK	7-02-82	2860.0	SS30	2.8	21.1	0.006	0.058	194.629	0.0	0.002	0.001
NO CATALYST			0% O2										
815242	0	NONE	8-13-82	3184.0	SS30	169.3	21.2	0.363	4.387	186.507	1.212	0.362	0.897
815245	0	NONE	8-17-82	3213.0	SS30	166.5	21.3	0.349	4.393	184.963	1.300	0.348	0.773
815247	0	NONE	8-17-82	3235.0	SS30	159.6	21.4	0.340	4.622	183.618	1.188	0.339	0.788
NO CATALYST			3% O2										
815253	3	NONE	8-20-82	3340.0	SS30	142.1	21.8	0.327	4.296	181.356	1.147	0.326	0.848
815256	3	NONE	8-25-82	3396.0	SS30	141.3	20.6	0.336	4.122	192.444	1.242	N/A	0.924
815259	3	NONE	8-26-82	3425.0	SS30	104.0	21.5	0.314	4.184	184.098	1.200	N/A	0.897
NO CATALYST			5% O2										
815267	5	NONE	9-10-82	3595.5	SS30	107.1	21.2	0.319	4.447	185.846	1.158	N/A	0.930
815269	5	NONE	9-10-82	3625.0	SS30	108.2	21.0	0.321	4.519	187.998	1.211	N/A	0.898
815271	5	NONE	9-14-82	3662.0	SS30	130.6	21.2	0.323	4.201	186.415	1.174	N/A	0.910
4X6 12:1(#1)			0% O2										
816032	0	(#1)	9-16-82	3747.0	SS30	0.3	21.6	0.002	0.017	190.880	0.002	0.001	0.002
815994	0	(#1)	9-21-82	3828.0	SS30	0.4	21.5	0.003	0.028	191.718	0.005	0.002	0.008
4X6-12:1(#1)			3% O2										
816002	3	(#1)	9-29-82	3983.0	SS30	0.90	21.5	0.008	0.001	191.581	1.140	0.004	0.002
4X6-12:1(#1)			5% O2										
816008	5	(#1)	10-01-82	4065.0	SS30	0.6	21.4	0.008	0.0	192.321	1.174	0.005	0.003
816010	5	(#1)	10-01-82	4100.0	SS30	2.2	21.2	0.008	0.0	194.049	1.262	0.004	N/A
4X6-12:1(#1)			3% O2	(AGAIN)									
816017	3	(#1)	10-08-82	4229.9	SS30	2.7	21.2	0.008	0.0	194.449	1.215	0.005	0.005
816019	3	(#1)	10-08-82	4236.5	SS30	3.0	21.6	0.009	0.0	190.452	1.210	0.006	0.004
NO CATALYST			0% O2										
816025	0	NONE	10-14-82	4353.0	SS30	110.4	21.3	0.336	4.265	185.561	1.260	0.334	0.873
6XRIO-12:1(#2)			0% O2										
816563	0	(#2)	10-19-82	4450.0	SS30	0.5	21.7	0.006	0.0	189.783	0.395	0.004	0.024
816571	0	(#2)	11-02-82	4625.0	SS30	6.7	21.0	0.007	0.023	196.256	0.562	0.005	N/A
6XRIO-12:1(#2)			5% O2										
816579	5	(#2)	11-05-82	4768.0	SS30	5.6	20.3	0.010	0.029	203.143	1.218	0.007	0.052

NO CAT CHECK OUT		5% O2										
816585*	5 NONE	11-19-82	4888.0	SS30	N/A	17.1	0.138	4.214	233.636	0.385	0.133	N/A
NO CATALYST		0% O2										
816599	0 NONE	12-07-82	5140.0	SS30	104.9	20.4	0.354	4.752	192.987	1.156	0.351	N/A
816603	0 NONE	12-08-82	5192.0	SS30	109.8	20.9	0.341	4.967	188.026	1.182	0.338	N/A
4X6-3:2 (#3)		0% O2										
816611	0 (#3)	12-14-82	5321.0	SS30	N/A	21.0	0.006	0.189	195.774	0.027	N/A	N/A
816613	0 (#3)	12-15-82	5343.0	SS30	N/A	20.2	0.013	0.250	203.138	0.061	0.009	N/A
4X6-3:2 (#3)		3% O2										
816616	3 (#3)	12-16-82	5403.0	SS30	N/A	20.2	0.017	0.0	204.257	1.277	0.014	N/A
816620	3 (#3)	12-17-82	5454.0	SS30	N/A	19.4	0.058	0.034	211.459	1.194	0.055	0.168
817461	3 (#3)	12-21-82	5504.0	SS30	70.74	20.0	0.033	0.006	206.135	1.219	0.029	0.042
4X6-3:2 (#3)		5% O2										
817467	5 (#3)	1-04-83	5599.6	SS30	98.95	19.6	0.100	0.123	209.362	1.224	N/A	N/A
817469	5 (#3)	1-04-83	5612.0	SS30	114.98	20.8	0.024	0.006	198.279	1.088	N/A	N/A
NO CATALYST		0% O2										
817473	0 NONE	1-05-83	5668.0	SS30	72.28	19.8	0.415	5.372	198.553	1.306	N/A	N/A
4X6-100PD(#4)		0% O2										
817475	0 (#4)	1-06-83	5680.0	SS30	3.28	20.4	0.014	0.475	201.469	0.005	N/A	0.036
817483	0 (#4)	1-12-83	5808.0	SS30	3.78	20.2	0.013	0.627	202.518	0.010	0.010	N/A
4X6-100PD(#4)		3% O2										
817487	3 (#4)	1-13-83	5869.0	SS30	21.6	20.4	0.010	0.006	201.947	1.026	0.006	N/A
817491	3 (#4)	1-14-83	5921.0	SS30	14.8	20.7	0.009	0.006	199.129	1.083	0.006	N/A
4X6-100PD(#4)		5% O2										
817494	5 (#4)	1-18-83	5968.4	SS30	22.9	20.7	0.011	0.007	198.854	1.073	0.007	N/A
817498*	5 (#4)	1-19-83	6020.0	SS30	41.4	19.7	0.013	0.018	209.224	1.179	0.010	N/A
NO CATALYST		0% O2										
817924	0 NONE	1-27-83	6118.0	SS30	121.95	N/A	0.387	6.004	N/A	1.088	0.384	N/A
4X6-PDBM(#5)		0% O2										
817928*	0 (#5)	1-28-83	6172.0	SS30	N/A	N/A	0.064	3.635	N/A	0.973	0.063	N/A
817932*	0 (#5)	2-01-83	6225.0	SS30	N/A	N/A	0.080	3.620	N/A	1.053	0.078	N/A
4X6-PDBM(#5)		3% O2										
817936*	3 (#5)	2-02-83	6282.0	SS30	N/A	20.7	0.097	3.659	192.641	1.125	0.095	N/A
4X6-PDBM(#5)		0% O2										
817942	0 (#5)	2-09-83	6428.0	SS30	38.05	21.5	0.066	2.199	187.403	1.109	0.063	N/A
817946*	0 (#5)	2-10-83	6481.0	SS30	47.53	N/A	0.072	2.548	-1.0	1.126	0.069	N/A

4X6-PDBM(#5)		3% O2										
817950*	3 (#5)	2-11-83	6535.0	SS30	N/A	N/A	0.125	3.246	-1.0	1.057	0.122	N/A
817954	3 (#5)	2-15-83	6591.0	SS30	N/A	21.2	0.137	3.977	187.662	1.067	0.132	N/A
4X6-PDBM(#5)		5% O2										
818395	5 (#5)	2-17-83	6688.0	SS30	N/A	20.9	0.258	4.576	188.833	1.094	0.254	N/A
818399	5 (#5)	2-18-83	6743.0	SS30	N/A	21.5	0.252	4.470	184.026	1.056	0.247	N/A
4X6 CU833(#6)		0% O2										
818407	0 (#6)	2-24-83	6874.0	SS30	N/A	21.2	0.394	4.871	185.177	1.113	0.390	N/A
818411	0 (#6)	2-25-83	6930.0	SS30	N/A	20.9	0.403	5.220	187.372	1.119	0.397	N/A
4X6-CU833(#6)		3% O2										
818415	3 (#6)	3-01-83	7000.0	SS30	N/A	21.0	0.408	4.342	188.013	1.107	0.405	N/A
818647	3 (#6)	3-02-83	7053.2	SS30	N/A	20.8	0.412	5.056	189.016	1.119	0.408	N/A
4X6-CU833(#6)		5% O2										
818651	5 (#6)	3-03-83	7108.8	SS30	N/A	21.3	0.288	3.456	186.539	0.816	0.285	N/A
818655	5 (#6)	3-04-83	7159.1	SS30	N/A	20.5	0.375	4.370	192.543	1.113	0.368	N/A
4X6-20PD(#7)		0% O2										
818663	0 (#7)	3-10-83	7294.7	SS30	N/A	20.8	0.018	1.332	195.359	0.015	0.013	N/A
818667	0 (#7)	3-11-83	7348.0	SS30	N/A	20.7	0.012	0.862	197.413	0.030	0.007	N/A
818724	0 (#7)	3-15-83	7399.0	SS30	N/A	20.9	0.009	1.184	195.432	0.010	0.004	N/A
4X6-20PD(#7)		3% O2										
818728	3 (#7)	3-16-83	7454.0	SS30	N/A	21.4	0.009	-0.004	192.800	1.018	0.005	N/A
818732	3 (#7)	3-17-83	7506.0	SS30	N/A	21.0	0.008	0.007	195.931	1.012	0.004	N/A
4X6-20PD(#7)		5% O2										
818736	5 (#7)	3-18-83	7563.0	SS30	N/A	21.4	0.009	0.011	192.34	1.018	0.005	N/A
818740	5 (#7)	3-22-83	7614.0	SS30	N/A	21.1	0.009	0.006	195.22	1.074	N/A	N/A
818977	5 (#7)	3-23-83	7666.0	SS30	-1.0	21.0	0.009	-.004	196.370	1.111	N/A	N/A
4X6-AG(#8)		0% O2										
818993	0 (#8)	4-07-83	7974.8	SS30	N/A	21.9	0.221	4.090	180.868	0.971	0.217	N/A
818997	0 (#8)	4-08-83	8026.0	SS30	-1.0	20.9	0.233	4.086	189.955	1.108	0.2287	N/A
4X6-AG(#8)		3% O2										
819244	3 (#8)	4-21-83	8259.0	SS30	-1.0	21.9	0.134	4.383	181.073	0.967	0.1295	N/A
819248	3 (#8)	4-22-83	8392.0	SS30	-1.0	22.0	0.121	4.898	178.946	0.908	N/A	N/A

NUMBER	O2	CAT#	DATE	ODOM	IPRO	ALDY	MPG	HC	CO	CO2	NOX	HC-NM	METHANOL
STOCK CATALYST													
814215	9	STOCK	6-29-82	2685.0	SS40	0.5	21.5	0.002	0.016	191.641	0.032	0.002	0.002
814218	9	STOCK	6-30-82	2739.4	SS40	0.00	20.0	0.002	0.0	206.162	0.256	0.000	0.001
814221	9	STOCK	7-01-82	2810.0	SS40	0.64	20.8	0.001	0.028	198.055	0.055	0.002	0.001
814224	9	STOCK	7-02-82	2860.0	SS40	0.54	20.8	0.003	0.036	198.112	0.015	0.003	0.002
NO CATALYST			0% O2										
815243'	0	NONE	8-13-82	3192.0	SS40	197.7	18.7	0.381	4.229	212.537	1.843	0.381	1.024
815245	0	NONE	8-17-82	3213.0	SS40	170.5	21.6	0.309	3.813	183.906	1.583	0.308	0.722
815247	0	NONE	8-17-82	3235.0	SS40	166.3	19.5	0.329	4.076	203.190	1.698	0.328	0.926
NO CATALYST			3% O2										
815253	3	NONE	8-20-82	3340.0	SS40	150.9	20.6	0.290	4.245	192.367	1.601	0.289	0.774
815256	3	NONE	8-25-82	3396.0	SS40	N/A	20.1	0.289	4.082	197.967	1.693	N/A	0.828
815259	3	NONE	8-26-82	3425.0	SS40	119.9	19.8	0.299	3.865	201.364	1.639	N/A	0.947
NO CATALYST			5% O2										
815267	5	NONE	9-10-82	3595.5	SS40	113.5	19.4	0.307	3.895	205.590	1.761	N/A	0.789
815269	5	NONE	9-10-82	3625.0	SS40	117.4	20.0	0.283	3.969	198.963	1.695	N/A	0.743
815271	5	NONE	9-14-82	3662.0	SS40	119.6	20.2	0.291	4.074	196.239	1.627	N/A	0.891

APPENDIX 5

Statistics with the Data
Stratified by Oxygen Level,
Test Cycle, and Individual Catalyst

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-------   --------------------------688226----------------688226----------------688226----------------688226-------

OB NUMBER 688226        UNIVERSITY OF MICHIGAN TERMINAL SYSTEM  (MODEL AR173)          17:03:01 EDT       TUE MAY 10/83
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                    USER: SNH4  PROJECT: SAMV

                    OBTAINED AT 17:03:01  TUE MAY 10/83
                    RELEASED AT 17:03:03  TUE MAY 10/83

                    LINES PRINTED     1374
                    PAGES PRINTED       48


 666666666   888888888    888888888    2222222222   2222222222    666666666
66666666666 88888888888  88888888888  222222222222 222222222222  66666666666
66      66  88      88   88      88   22      22   22      22   66      66
66          88      88   88      88           22           22   66
66           88    88     88    88            22           22   66
6666666666    888888      8888888            22           22    6666666666
66666666666   888888      8888888          22           22     66666666666
66      66   88    88     88    88       22           22       66      66
66      66  88      88   88      88    22           22         66      66
66      66  88      88   88      88   22           22          66      66
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 666666666   888888888    888888888   222222222222 222222222222   666666666


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         SSSSSSSSSSSS  NNN       NN  HH        HH      4444
         SS        SS  NNNN      NN  HH        HH     44 44
         SS            NN NN     NN  HH        HH    44  44
         SSS           NN  NN    NN  HH        HH   44   44
          SSSSSSSSS    NN   NN   NN  HHHHHHHHHHHH  44444444444
           SSSSSSSSS   NN    NN  NN  HHHHHHHHHHHH  44444444444
                 SSS   NN     NN NN  HH        HH        44
                  SS   NN      NNNN  HH        HH        44
         SS       SS   NN       NNN  HH        HH        44
         SSSSSSSSSSSS  NN        NN  HH        HH        44
          SSSSSSSSSS   NN         N  HH        HH        44
```

CATALYSTS 5-1a

CODE	Number
12 Pt: Pd (40)	1
12 Pt: Rh (40)*	2
3 Pt: 2 Pd (20)	3
Pd (40)	4
Pd + BM	5
Cu mesh	6
Pd (20)	7
Ag (150)	8
5 Pt: Rh (40)	stock

```
<DESCRIBE BYSTRATA VAR=9-12.14.16 STRAT=V2*V3*V6>

DESCRIPTIVE MEASURES  <1> OXY:0*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN      STD DEV

   9.ALDY            3  8.5000     13.200      11.833     2.7135

  10.MPG             3  13.886     14.011      13.968     .70474 -1

  11.HC              3  .10050     .12220      .11073     .10902 -1

  12.CO              3  .41650     .93400      .69300     .26057

  14.NOX             3  .49670     .70000      .62110     .10902

  16.METHANOL        2  .30400     .35300      .32850     .34648 -1

DESCRIPTIVE MEASURES  <2> OXY:3*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN      STD DEV

   9.ALDY            3  12.900     17.500      15.600     2.4021

  10.MPG             3  13.624     14.556      14.016     .48354

  11.HC              3  .11310     .12810      .11870     .81902 -2

  12.CO              3  .31320     .50300      .38760     .10133

  14.NOX             3  1.8790     2.0981      2.0062     .11372

  16.METHANOL        3  .29100     .31600      .30667     .13650 -1

DESCRIPTIVE MEASURES  <3> OXY:5*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN      STD DEV

   9.ALDY            4  18.900     22.100      20.975     1.4863

  10.MPG             4  13.762     14.107      13.910     .15415

  11.HC              4  .10620     .13830      .12435     .12528 -1

  12.CO              4  .32300     .48190      .39927     .66670 -1

  14.NOX             2  2.0731     2.1175      2.0953     .31396 -1

  16.METHANOL        4  .26900     .37500      .31700     .43932 -1

DESCRIPTIVE MEASURES  <4> OXY:0*CAT:(#2)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN      STD DEV

   9.ALDY            2  9.9000     13.000      11.450     2.1920

  10.MPG             2  13.826     14.078      13.952     .17847

  11.HC              2  .11170     .14940      .13055     .26658 -1
  12.CO              2  .70390     .84030     .77210     .96449 -1
  14.NOX             2  .75530     .76720     .76125     .84146 -2
  16.METHANOL        1  .82000     .82000     .82000

DESCRIPTIVE MEASURES  <5> OXY:3*CAT:(#2)*TPRO:FTP
     VARIABLE        N  MINIMUM    MAXIMUM     MEAN      STD DEV
   9.ALDY            3  13.300     15.100     14.433     .98658
  10.MPG             3  13.672     13.827     13.737     .80625 -1
  11.HC              3  .11990     .13490     .12837     .76846 -2
  12.CO              3  .23500     .50650     .40320     .14720
  14.NOX             3  2.0242     2.0692     2.0455     .22030 -1
  16.METHANOL        0

DESCRIPTIVE MEASURES  <6> OXY:5*CAT:(#2)*TPRO:FTP
     VARIABLE        N  MINIMUM    MAXIMUM     MEAN      STD DEV
   9.ALDY            1  20.800     20.800     20.800
  10.MPG             1  13.763     13.763     13.763
  11.HC              1  .13130     .13130     .13130
  12.CO              1  .45920     .45920     .45920
  14.NOX             1  2.0939     2.0939     2.0939
  16.METHANOL        0

DESCRIPTIVE MEASURES  <7> OXY:0*CAT:(#3)*TPRO:FTP
     VARIABLE        N  MINIMUM    MAXIMUM     MEAN      STD DEV
   9.ALDY            1  29.500     29.500     29.500
  10.MPG             3  13.648     13.879     13.780     .11874
  11.HC              3  .14620     .16070     .15443     .74474 -2
  12.CO              3  1.3575     1.6463     1.4676     .15612
  14.NOX             3  .83930     .87030     .85300     .15810 -1
  16.METHANOL        0

DESCRIPTIVE MEASURES  <8> OXY:3*CAT:(#3)*TPRO:FTP
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```
    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV
     9.ALDY           1  72.900      72.900      72.900
   10.MPG             2  13.365      13.496      13.430      .92702 -1
   11.HC              2  .15660      .16360      .16010      .49497 -2
   12.CO              2  .34530      .35530      .35030      .70711 -2
   14.NOX             2  2.0517      2.0855      2.0686      .23900 -1
   16.METHANOL        2  .21200      .34000      .27600      .90510 -1

DESCRIPTIVE MEASURES   <9> OXY:5*CAT:(#3)*TPRO:FTP
    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV
     9.ALDY           2  117.30      117.40      117.35      .70711 -1
   10.MPG             2  13.485      13.538      13.511      .37547 -1
   11.HC              2  .18100      .19940      .19020      .13011 -1
   12.CO              2  .34490      .44060      .39525      .64135 -1
   14.NOX             2  1.9743      2.0929      2.0336      .83863 -1
   16.METHANOL        2  .29600      .42300      .35950      .89803 -1

DESCRIPTIVE MEASURES   <10> OXY:0*CAT:(#4)*TPRO:FTP
    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV
     9.ALDY           3  38.550      46.900      41.547      4.6472
   10.MPG             3  13.412      13.552      13.470      .73140 -1
   11.HC              3  .15330      .19020      .16903      .19041 -1
   12.CO              3  1.5873      2.2657      1.9869      .35495
   14.NOX             3  .72610      .75480      .74293      .14981 -1
   16.METHANOL        2  .33900      .35200      .34550      .91924 -2

DESCRIPTIVE MEASURES   <11> OXY:3*CAT:(#4)*TPRO:FTP
    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV
     9.ALDY           2  59.330      76.650      67.990      12.247
   10.MPG             2  13.367      13.495      13.431      .90722 -1
   11.HC              2  .13840      .15140      .14490      .91924 -2
   12.CO              2  .36570      .39360      .37965      .19728 -1
   14.NOX               2  1.9570     2.0082     1.9826     .36204 -1

   16.METHANOL          0

DESCRIPTIVE MEASURES   <12> UXY:5*CAT:(#4)*TPRO:FTP

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN     STD DEV

    9.ALDY              3  111.29     172.67     141.87     30.691

   10.MPG               3  13.227     13.324     13.264     .52472 -1

   11.HC                3  .15100     .17540     .15983     .13522 -1

   12.CO                3  .28640     .45780     .35650     .89859 -1

   14.NOX               3  1.9532     2.1090     2.0516     .85634 -1

   16.METHANOL          0

DESCRIPTIVE MEASURES   <13> UXY:0*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN     STD DEV

    9.ALDY              2  118.46     119.24     118.85     .55154

   10.MPG               1  14.141     14.141     14.141

   11.HC                2  .27670     .27700     .27685     .21213 -3

   12.CO                2  2.7232     2.9788     2.8510     .18074

   14.NOX               2  1.9502     1.9934     1.9718     .30547 -1

   16.METHANOL          0

DESCRIPTIVE MEASURES   <14> UXY:3*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN     STD DEV

    9.ALDY              2  117.52     141.23     129.37     16.766

   10.MPG               1  13.895     13.895     13.895

   11.HC                2  .27490     .28110     .27800     .43841 -2

   12.CO                2  1.9386     2.1652     2.0519     .16023

   14.NOX               2  1.8986     2.0035     1.9510     .74176 -1

   16.METHANOL          0

DESCRIPTIVE MEASURES   <15> UXY:5*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN     STD DEV
```

```
 9.ALDY              3  253.12      304.58      279.53      25.757
10.MPG               3  13.749      13.914      13.852      .89851 -1
11.HC                3  .35840      .37090      .36663      .71319 -2
12.CO                3  3.3620      3.9338      3.6550      .28616
14.NOX               3  1.9139      1.9529      1.9378      .20936 -1
16.METHANOL          0

DESCRIPTIVE MEASURES   <16> UXY:0*CAT:(#6)*TPRO:FTP
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
 9.ALDY              2  268.82      315.03      291.92      32.675
10.MPG               2  13.663      13.724      13.693      .43275 -1
11.HC                2  .90070      .90530      .90300      .32527 -2
12.CO                2  7.3105      7.7205      7.5155      .28991
14.NOX               2  1.8650      1.9046      1.8848      .28001 -1
16.METHANOL          0

DESCRIPTIVE MEASURES   <17> UXY:3*CAT:(#6)*TPRO:FTP
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
 9.ALDY              2  312.47      332.15      322.31      13.916
10.MPG               2  13.433      13.449      13.441      .11243 -1
11.HC                2  .88460      .92010      .90235      .25102 -1
12.CO                2  7.2143      7.3714      7.2928      .11109
14.NOX               2  1.8147      1.8197      1.8172      .35355 -2
16.METHANOL          0

DESCRIPTIVE MEASURES   <18> UXY:5*CAT:(#6)*TPRO:FTP
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
 9.ALDY              2  303.13      324.61      313.87      15.189
10.MPG               2  13.435      13.506      13.471      .50134 -1
11.HC                2  .83240      .90550      .86895      .51690 -1
12.CO                2  6.8828      6.9835      6.9331      .71206 -1
14.NOX               2  1.8135      1.8320      1.8227      .13081 -1
```

```
16.METHANOL          0

DESCRIPTIVE MEASURES   <19> OXY:0*CAT:(#7)*TPRO:FTP
   VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
  9.ALDY               3  35.350       48.630       41.030      6.8450
 10.MPG                3  13.682       13.915       13.810      .11846
 11.HC                 3  .16680       .20080       .18483      .17094 -1
 12.CO                 3  1.4919       2.0945       1.8392      .31166
 14.NOX                3  .62510       .70290       .66630      .39103 -1
 16.METHANOL           0

DESCRIPTIVE MEASURES   <20> OXY:3*CAT:(#7)*TPRO:FTP
   VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
  9.ALDY               2  88.670       99.720       94.195      7.8135
 10.MPG                2  13.766       13.900       13.833      .94964 -1
 11.HC                 2  .14590       .15980       .15285      .98288 -2
 12.CO                 2  .39410       .40400       .39905      .70004 -2
 14.NOX                2  1.8530       1.9380       1.8955      .60104 -1
 16.METHANOL           0
```

~~DESCRIPTIVE MEASURES <21> OXY:5*CAT:(#7)*TPRO:FTP~~

~~VARIABLE N MINIMUM MAXIMUM MEAN STD DEV~~

~~9.ALDY 3 102.16 115.28 107.75 6.7703~~

~~10.MPG 3 11.793 13.770 13.067 1.1056~~

~~11.HC 3 .12881 .26690 .17924 .77852 -1~~

~~12.CO 3 .29930 1.4443 .69130 .65572~~

~~14.NOX 3 1.8934 1.9080 1.9026 .80314 -2~~

~~16.METHANOL 0~~

Corrected, see last page of appendix.

```
DESCRIPTIVE MEASURES   <22> OXY:0*CAT:(#8)*TPRO:FTP
   VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
  9.ALDY               3  41.800       66.040       55.433      12.400
```

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```
  10.MPG               4  13.765    14.036     13.853     .12764
  11.HC                4  .44600    .61130     .53958     .68705 -1
  12.CO                4  6.2919    6.6857     6.5252     .16906
  14.NOX               4  2.0083    2.0506     2.0282     .18448 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES  <23> OXY:3*CAT:(#8)*THRU:FTP
    VARIABLE           N  MINIMUM   MAXIMUM     MEAN      STD DEV
   9.ALDY              0
  10.MPG               3  13.601    13.877     13.709     .14700
  11.HC                3  .35266    .47811     .42799     .66416 -1
  12.CO                3  5.4735    6.4773     5.9313     .50769
  14.NOX               3  1.9775    2.0052     1.9892     .14357 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES  <24> OXY:5*CAT:(#8)*THRU:FTP
    VARIABLE           N  MINIMUM   MAXIMUM     MEAN      STD DEV
   9.ALDY              0
  10.MPG               1  13.786    13.786     13.786
  11.HC                1  .54175    .54175     .54175
  12.CO                1  6.9620    6.9620     6.9620
  14.NOX               1  1.8919    1.8919     1.8919
  16.METHANOL          0

DESCRIPTIVE MEASURES  <25> OXY:0*CAT:NONE*THRU:FTP
    VARIABLE           N  MINIMUM   MAXIMUM     MEAN      STD DEV
   9.ALDY             11  131.60    325.72     241.59     60.265
  10.MPG              13  13.399    14.172     13.888     .24119
  11.HC               14  .78480    1.0565     .91903     .86235 -1
  12.CO               14  7.1922    8.4891     7.5196     .39120
  14.NOX              14  1.9656    2.2062     2.0832     .90125 -1
  16.METHANOL          4  1.7830    2.4530     2.1767     .28197
```

```
DESCRIPTIVE MEASURES  <26> OXY:3*CAT:NONE*TPRO:FTP
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
   9.ALDY             3  252.60     281.30      264.33     15.049
  10.MPG              5  13.686     14.068      13.934     .15061
  11.HC               5  .76950     1.0762      .91690     .14370
  12.CO               5  7.1572     7.3910      7.2550     .91648 -1
  14.NOX              5  2.0030     2.1688      2.0925     .59006 -1
  16.METHANOL         3  2.0180     2.1350      2.0820     .59271 -1

DESCRIPTIVE MEASURES  <27> OXY:5*CAT:NONE*TPRO:FTP
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
   9.ALDY             4  185.00     205.00      194.22     8.9489
  10.MPG              6  13.464     13.957      13.826     .18513
  11.HC               6  .76750     1.1244      .90380     .14992
  12.CO               6  7.2400     7.9505      7.5138     .28089
  14.NOX              6  1.9903     2.1911      2.0887     .65312 -1
  16.METHANOL         3  2.4130     2.5300      2.4617     .60929 -1

DESCRIPTIVE MEASURES  <28> OXY:0*CAT:STOCK*TPRO:FTP
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
   9.ALDY             4  17.200     26.300      20.275     4.2437
  10.MPG              6  13.922     14.725      14.183     .27826
  11.HC               6  .13560     .19020      .15465     .19086 -1
  12.CO               6  .69570     .90010      .78385     .82330 -1
  14.NOX              4  .53040     1.6792      .83737     .56187
  16.METHANOL         4  .14200     .30300      .20550     .70420 -1

DESCRIPTIVE MEASURES  <29> OXY:3*CAT:STOCK*TPRO:FTP
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
   9.ALDY             1  15.400     15.400      15.400
  10.MPG              1  13.752     13.752      13.752
  11.HC               1  .14310     .14310      .14310
```

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    12.CO                  1  .60340      .60340      .60340
    14.NOX                 1  1.9496      1.9496      1.9496
    16.METHANOL            1  .58700      .58700      .58700

DESCRIPTIVE MEASURES  <31> OXY:0*CAT:(#1)*TPRO:HWY
      VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY              3  .30000      1.0000      .53333      .40415
    10.MPG               3  17.219      17.439      17.318      .11160
    11.HC                3  .30000 -2   .41000 -2   .33667 -2   .63509 -3
    12.CO                3  .26900 -1   .64000 -1   .48300 -1   .19196 -1
    14.NOX               3  .58040      .63290      .61050      .27084 -1
    16.METHANOL          2  .60000 -2   .12000 -1   .90000 -2   .42426 -2

DESCRIPTIVE MEASURES  <32> OXY:3*CAT:(#1)*TPRO:HWY
      VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY              3  1.0000      1.6000      1.2333      .32146
    10.MPG               3  17.081      18.712      17.745      .85690
    11.HC                3  .81000 -2   .94000 -2   .86333 -2   .68069 -3
    12.CO                3  0.          .85000 -2   .45333 -2   .42782 -2
    14.NOX               3  2.4257      2.8921      2.7338      .26688
    16.METHANOL          3  .40000 -2   .50000 -2   .43333 -2   .57735 -3

DESCRIPTIVE MEASURES  <33> OXY:5*CAT:(#1)*TPRO:HWY
      VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY              4  1.7000      2.2000      1.9250      .20616
    10.MPG               4  17.223      17.517      17.389      .12546
    11.HC                4  .77000 -2   .11400 -1   .96500 -2   .15155 -2
    12.CO                4  0.          .70000 -2   .21750 -2   .33150 -2
    14.NOX               3  2.7040      2.9207      2.7820      .12045
    16.METHANOL          4  .40000 -2   .90000 -2   .60000 -2   .21602 -2

DESCRIPTIVE MEASURES  <34> OXY:0*CAT:(#2)*TPRO:HWY
```

```
     VARIABLE           N  MINIMUM      MAXIMUM      MEAN        STD DEV
   9.ALDY               3  .80000       1.6000       1.1667      .40415
  10.MPG                3  17.147       18.046       17.721      .49843
  11.HC                 3  .50000 -2   .12900 -1   .83000 -2   .41073 -2
  12.CO                 3  .57200 -1   .67100 -1   .62533 -1   .49943 -2
  14.NOX                3  .47520       .69750       .55043      .12737
  16.METHANOL           2  .40000 -2   .65000 -1   .34500 -1   .43134 -1

DESCRIPTIVE MEASURES  <35> OXY:3*CAT:(#2)*TPRO:HWY
     VARIABLE           N  MINIMUM      MAXIMUM      MEAN        STD DEV
   9.ALDY               3  1.6000       2.3000       2.0333      .37859
  10.MPG                3  17.295       17.442       17.368      .73406 -1
  11.HC                 3  .82000 -2   .93000 -2   .87333 -2   .55076 -3
  12.CO                 3  .23400 -1   .27600 -1   .25033 -1   .22502 -2
  14.NOX                3  2.8026       2.8602       2.8384      .31270 -1
  16.METHANOL           3  .90000 -2   .23000 -1   .14000 -1   .78102 -2

DESCRIPTIVE MEASURES  <36> OXY:5*CAT:(#2)*TPRO:HWY
     VARIABLE           N  MINIMUM      MAXIMUM      MEAN        STD DEV
   9.ALDY               1  2.2000       2.2000       2.2000
  10.MPG                1  17.366       17.366       17.366
  11.HC                 1  .98000 -2   .98000 -2   .98000 -2
  12.CO                 1  .28200 -1   .28200 -1   .28200 -1
  14.NOX                1  2.7982       2.7982       2.7982
  16.METHANOL           1  .27000 -1   .27000 -1   .27000 -1

DESCRIPTIVE MEASURES  <37> OXY:0*CAT:(#3)*TPRO:HWY
     VARIABLE           N  MINIMUM      MAXIMUM      MEAN        STD DEV
   9.ALDY               1  .91000       .91000       .91000
  10.MPG                3  16.919       17.344       17.155      .21603
  11.HC                 3  .61000 -2   .90000 -2   .73333 -2   .14978 -2
  12.CO                 3  .19850       .23120       .21637      .16560 -1
```

```
   14.NOX              3  .62550     .64780     .63983      .12439 -1
   16.METHANOL         0

DESCRIPTIVE MEASURES  <38> UXY:3*CAT:(#3)*TPRU:HWY
     VARIABLE          N  MINIMUM    MAXIMUM     MEAN       STD DEV
    9.ALDY             1  1.7000     1.7000     1.7000
   10.MPG              3  16.803     17.079     16.918      .14392
   11.HC               3  .95000 -2  .10000 -1  .98000 -2  .26458 -3
   12.CO               3  .60000 -3  .17400 -1  .62000 -2  .96995 -2
   14.NOX              3  2.7388     2.8118     2.7695      .37842 -1
   16.METHANOL         2  .11000 -1  .16000 -1  .13500 -1  .35355 -2

DESCRIPTIVE MEASURES  <39> UXY:5*CAT:(#3)*TPRU:HWY
     VARIABLE          N  MINIMUM    MAXIMUM     MEAN       STD DEV
    9.ALDY             2  2.9300     3.0400     2.9850      .77782 -1
   10.MPG              2  17.011     17.081     17.046      .49285 -1
   11.HC               2  .92000 -2  .10000 -1  .96000 -2  .56569 -3
   12.CO               2  .50000 -3  .78000 -2  .41500 -2  .51619 -2
   14.NOX              2  2.7420     2.8272     2.7846      .60245 -1
   16.METHANOL         2  .90000 -2  .90000 -2  .90000 -2

DESCRIPTIVE MEASURES  <40> UXY:0*CAT:(#4)*TPRU:HWY
     VARIABLE          N  MINIMUM    MAXIMUM     MEAN       STD DEV
    9.ALDY             3  .36000     1.1000     .72333      .37018
   10.MPG              3  16.909     17.044     16.976      .67453 -1
   11.HC               3  .43000 -2  .64000 -2  .55000 -2  .10817 -2
   12.CO               3  .29880     .34550     .32620      .24381 -1
   14.NOX              3  .42810     .57360     .50747      .73647 -1
   16.METHANOL         2  .80000 -2  .24000 -1  .16000 -1  .11314 -1

DESCRIPTIVE MEASURES  <41> UXY:3*CAT:(#4)*TPRU:HWY
     VARIABLE          N  MINIMUM    MAXIMUM     MEAN       STD DEV
     9.ALDY             2  1.6700      1.9000      1.7850      .16263
    10.MPG              2  17.010      17.081      17.046      .50205 -1
    11.HC               2  .73000 -2   .90000 -2   .81500 -2   .12021 -2
    12.CO               2  .86000 -2   .14400 -1   .11500 -1   .41012 -2
    14.NOX              2  2.6469      2.6516      2.6492      .33234 -2
    16.METHANOL         0

DESCRIPTIVE MEASURES  <42> UXY:5*CAT:(#4)*TPRO:HWY
      VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             2  2.6500      2.8000      2.7250      .10607
    10.MPG              2  16.940      17.081      17.010      .99419 -1
    11.HC               2  .86000 -2   .94000 -2   .90000 -2   .56569 -3
    12.CO               2  .10700 -1   .14500 -1   .12600 -1   .26870 -2
    14.NOX              2  2.7164      2.7267      2.7215      .72832 -2
    16.METHANOL         0

DESCRIPTIVE MEASURES  <43> UXY:0*CAT:(#5)*TPRO:HWY.
      VARIABLE          N  MINIMUM     MAXIMUM       MEAN .    STD DEV
     9.ALDY             2  2.6400      3.5900      3.1150      .67175
    10.MPG              1  17.588      17.588      17.588
    11.HC               2  .15000 -1   .16600 -1   .15800 -1   .11314 -2
    12.CO               2  1.3046      1.6607      1.4826      .25180
    14.NOX              2  1.5459      1.7229      1.6344      .12516
    16.METHANOL         0

DESCRIPTIVE MEASURES  <44> UXY:3*CAT:(#5)*TPRO:HWY
      VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             2  2.7600      3.2000      2.9800      31113
    10.MPG              1  17.510      17.510      17.510
    11.HC               2  .13200 -1   .13200 -1   .13200 -1
    12.CO               2  .30600 -1   .60800 -1   .45700 -1   .21355 -1
    14.NOX              2  2.5670      2.6360      2.6015      .48790 -1
    16.METHANOL          0

DESCRIPTIVE MEASURES  <45> OXY:5*CAT:(#5)*TPRU:HWY
     VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
      9.ALDY             2  11.480       17.460       14.470       4.2285
     10.MPG              2  17.553       17.836       17.695       .20039
     11.HC               2  .13300 -1   .14600 -1    .13950 -1    .91924 -3
     12.CO               2  .32970       .50450       .41710       .12360
     14.NOX              2  2.6354       2.6455       2.6404       .71418 -2
     16.METHANOL         0

DESCRIPTIVE MEASURES  <46> OXY:0*CAT:(#6)*TPRU:HWY
     VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
      9.ALDY             2  125.11       136.31       130.71       7.9196
     10.MPG              2  16.699       17.365       17.032       .47065
     11.HC               2  .26170       .34630       .30400       .59821 -1
     12.CO               2  6.8242       6.9953       6.9097       .12099
     14.NOX              2  2.3906       2.4293       2.4099       .27365 -1
     16.METHANOL         0

DESCRIPTIVE MEASURES  <47> OXY:3*CAT:(#6)*TPRU:HWY
     VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
      9.ALDY             2  136.34       137.98       137.16       1.1597
     10.MPG              2  16.904       17.020       16.962       .82307 -1
     11.HC               2  .19410       .20530       .19970       .79196 -2
     12.CO               2  6.3267       6.5169       6.4218       .13449
     14.NOX              2  2.2578       2.3029       2.2803       .31891 -1
     16.METHANOL         0

DESCRIPTIVE MEASURES  <48> OXY:5*CAT:(#6)*TPRU:HWY
     VARIABLE            N  MINIMUM      MAXIMUM       MEAN       STD DEV
      9.ALDY             2  121.33       127.17       124.25       4.1295
```

```
  10.MPG                2  16.536      16.914      16.726      .26587
  11.HC                 2  .13080      .16900      .14990      .27011 -1
  12.CO                 2  6.0667      6.2852      6.1759      .15450
  14.NOX                2  2.2044      2.2080      2.2065      .29698 -2
  16.METHANOL           0

DESCRIPTIVE MEASURES  <49> UXY:0*CAT:(#7)*TPRU:HWY
     VARIABLE           N  MINIMUM     MAXIMUM     MEAN        STD DEV
    9.ALDY              2  1.8700      1.9900      1.9300      .64853 -1
   10.MPG               3  17.107      17.398      17.255      .14522
   11.HC                3  .83000 -2   .10900 -1   .92000 -2   .14731 -2
   12.CO                3  .31810      .41220      .37653      .51014 -1
   14.NOX               3  .29720      .42240      .34757      .66089 -1
   16.METHANOL          0

DESCRIPTIVE MEASURES  <50> OXY:3*CAT:(#7)*TPRU:HWY
     VARIABLE           N  MINIMUM     MAXIMUM     MEAN        STD DEV
    9.ALDY              2  2.4400      2.9300      2.6850      .34648
   10.MPG               2  17.010      17.082      17.046      .50700 -1
   11.HC                2  .80000 -2   .85000 -2   .82500 -2   .35355 -3
   12.CO                2  0.          .10900 -1   .54500 -2   .77075 -2
   14.NOX               2  2.5117      2.5744      2.5430      .44336 -1
   16.METHANOL          0

DESCRIPTIVE MEASURES  <51> UXY:5*CAT:(#7)*TPRU:HWY
     VARIABLE           N  MINIMUM     MAXIMUM     MEAN        STD DEV
    9.ALDY              3  2.3800      3.3900      2.9000      .50567
   10.MPG               3  16.871      17.150      17.034      .14526
   11.HC                3  .79000 -2   .10550 -1   .89500 -2   .14080 -2
   12.CO                3  .50000 -3   .41000 -2   .28000 -2   .19975 -2
   14.NOX               3  2.5116      2.7254      2.6146      .10711
   16.METHANOL          0
```

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DESCRIPTIVE MEASURES  <52> OXY:0*CAT:(#6)*TPRU:HWY

    VARIABLE          N  MINIMUM      MAXIMUM       MEAN       STD DEV

     9.ALDY           3  1.9200       3.1500       2.3633      .68311

    10.MPG            3  17.024       17.159       17.101      .69714 -1

    11.HC             3  .20880 -1    .26900 -1    .23937 -    .30111 -2

    12.CO             3  4.0922       4.3635       4.2558      .14403

    14.NOX            3  2.7203       2.7685       2.7431      .24210 -1

    16.METHANOL       0

DESCRIPTIVE MEASURES  <53> OXY:3*CAT:(#8)*TPRU:HWY

    VARIABLE          N  MINIMUM      MAXIMUM       MEAN       STD DEV

     9.ALDY           0

    10.MPG            4  16.997       17.532       17.282      .23273

    11.HC             4  .16290 -1    .22770 -1    .18987 -1   .31200 -2

    12.CO             4  3.2917       3.6759       3.4695      .19307

    14.NOX            4  2.5562       2.7236       2.6422      .70632 -1

    16.METHANOL       0

DESCRIPTIVE MEASURES  <54> OXY:5*CAT:(#8)*TPRU:HWY

    VARIABLE          N  MINIMUM      MAXIMUM       MEAN       STD DEV

     9.ALDY           0

    10.MPG            2  17.513       18.889       18.201      .97263

    11.HC             2  .21340 -1    .23810 -1    .22575 -1   .17466 -2

    12.CO             2  5.0321       5.1001       5.0661      .48083 -1

    14.NOX            2  2.2555       2.5913       2.4234      .23745

    16.METHANOL       0

DESCRIPTIVE MEASURES  <55> OXY:0*CAT:NONE*TPRU:HWY

    VARIABLE          N  MINIMUM      MAXIMUM       MEAN       STD DEV

     9.ALDY          12  69.130       215.12       168.28      39.049

    10.MPG           13  16.639       17.502       17.196      .27712

    11.HC            14  .38390       .48780       .42815      .34613 -1
```

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  12.CO                  14  6.1530      7.0037      6.6671       .32974
  14.NOX                 14  2.5986      3.0248      2.8141       .13327
  16.METHANOL             5  .17900      .91800      .69280       .30907

DESCRIPTIVE MEASURES  <56> OXY:3*CAT:NONE*TPRO:HWY
     VARIABLE             N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY                 3  171.70      179.60      174.50      4.4238
  10.MPG                  5  17.081      17.526      17.340       .18174
  11.HC                   5  .36230      .47060      .40718       .53306 -1
  12.CO                   5  5.7837      6.7072      6.2162       .44049
  14.NOX                  5  2.6645      2.9541      2.8133       .10315
  16.METHANOL             3  .88800      .94800      .92733       .34078 -1

DESCRIPTIVE MEASURES  <57> OXY:5*CAT:NONE*TPRO:HWY
     VARIABLE             N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY                 4  139.50      147.00      141.70      3.5656
  10.MPG                  6  17.030      17.525      17.301       .19503
  11.HC                   6  .33430      .47930      .39817       .64608 -1
  12.CO                   6  5.9449      6.8053      6.3005       .32737
  14.NOX                  6  2.7454      2.9443      2.8384       .85373 -1
  16.METHANOL             3  .79500      .93700      .87167       .71675 -1

DESCRIPTIVE MEASURES  <58> OXY:0*CAT:STOCK*TPRO:HWY
     VARIABLE             N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY                 4  0.          .70000      .22500      .32016
  10.MPG                  4  17.969      18.201      18.084      .10126
  11.HC                   4  .60000 -3   .40000 -2   .16500 -2   .15864 -2
  12.CO                   4  .80700 -1   .15070      .11055      .34274 -1
  14.NOX                  4  .46500 -1   .13320      .91825 -1   .41128 -1
  16.METHANOL             4  .20000 -2   .70000 -2   .37500 -2   .22174 -2

DESCRIPTIVE MEASURES  <61> OXY:0*CAT:(*1)*TPRO:IDLE
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    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV

   9.ALDY             2  .30000 -1  .40000 -1  .35000 -1  .70711 -2

  10.MPG              2  129.00     137.00     133.00      5.6569

  11.HC               2  .11000 -2  .45000 -2  .28000 -2  .24042 -2

  12.CO               2  0.         0.         0.

  14.NOX              2  .34000 -2  .34000 -2  .34000 -2

  16.METHANOL         2  .43000 -2  .78000 -2  .60500 -2  .24749 -2

DESCRIPTIVE MEASURES  <62> OXY:3*CAT:(#1)*TPRO:IDLE

    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV

   9.ALDY             2  .28000     .37000     .32500      .63640 -1

  10.MPG              3  125.00     134.00     130.67      4.9329

  11.HC               3  .22000 -2  .26600 -1  .10733 -1  .13754 -1

  12.CO               3  .28000 -2  .17190     .60200 -1  .96747 -1

  14.NOX              3  .12800 -1  .24800 -1  .17400 -1  .64715 -2

  16.METHANOL         3  .14000 -2  .14900 -1  .10000 -1  .74719 -2

DESCRIPTIVE MEASURES  <63> OXY:5*CAT:(#1)*TPRO:IDLE

    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV

   9.ALDY             3  .75000     1.3300     .97333      .31214

  10.MPG              3  114.00     130.00     122.00      8.0000

  11.HC               3  .21000 -2  .21000 -2  .21000 -2

  12.CO               3  0.         0.         0.

  14.NOX              3  .81000 -2  .15100 -1  .11033 -1  .36350 -2

  16.METHANOL         2  .21000 -2  .22000 -2  .21500 -2  .70711 -4

DESCRIPTIVE MEASURES  <64> OXY:0*CAT:(#2)*TPRO:IDLE

    VARIABLE          N  MINIMUM     MAXIMUM      MEAN      STD DEV

   9.ALDY             2  .45000     1.3400     .89500      .62933

  10.MPG              2  134.00     146.00     140.00      8.4853

  11.HC               2  .20000 -2  .30000 -2  .25000 -2  .70711 -3

  12.CO               2  0.         0.         0.
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14.NOX              2  .53000 -2  .16900 -1  .11100 -1  .82024 -2

16.METHANOL         1  .12600 -1  .12600 -1  .12600 -1

DESCRIPTIVE MEASURES  <66> OXY:5*CAT:(#2)*TPRO:IDLE

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN      STD DEV

  9.ALDY            1  1.5200     1.5200     1.5200

 10.MPG             1  119.00     119.00     119.00

 11.HC              1  .37000 -2  .37000 -2  .37000 -2

 12.CO              1  .56000 -2  .56000 -2  .56000 -2

 14.NOX             1  .23100 -1  .23100 -1  .23100 -1

 16.METHANOL        1  .69000 -2  .69000 -2  .69000 -2

DESCRIPTIVE MEASURES  <67> OXY:0*CAT:(#3)*TPRO:IDLE

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN      STD DEV

  9.ALDY            0

 10.MPG             2  132.00     134.00     133.00      1.4142

 11.HC              2  .27000 -2  .47000 -2  .37000 -2  .14142 -2

 12.CO              2  .30000 -3  .27000 -2  .15000 -2  .16971 -2

 14.NOX             2  .52000 -2  .93000 -2  .72500 -2  .28991 -2

 16.METHANOL        0

DESCRIPTIVE MEASURES  <68> OXY:3*CAT:(#3)*TPRO:IDLE

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN      STD DEV

  9.ALDY            1  10.380     10.380     10.380

 10.MPG             3  112.00     124.00     117.00      6.2450

 11.HC              3  .58000 -2  .71500 -1  .32167 -1  .34716 -1

 12.CO              3  .10000 -3  .27120     .10910      .14314

 14.NOX             3  .23700 -1  .32900 -1  .27067 -1  .50718 -2

 16.METHANOL        1  .34200 -1  .34200 -1  .34200 -1

DESCRIPTIVE MEASURES  <69> OXY:5*CAT:(#3)*TPRO:IDLE

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN      STD DEV
 9.ALDY              2  49.640      56.260     52.950      4.6810
10.MPG               2  111.00      121.00     116.00      7.0711
11.HC                2  .35900 -1  .70900 -1  .53400 -1  .24749 -1
12.CO                2  .29000 -2  .56000 -2  .42500 -2  .19092 -2
14.NOX               2  .14100 -1  .18800 -1  .16450 -1  .33234 -2
16.METHANOL          0

DESCRIPTIVE MEASURES  <70> OXY:0*CAT:(#4)*TPRO:IDLE
   VARIABLE          N  MINIMUM    MAXIMUM      MEAN       STD DEV
 9.ALDY              3  .45000      14.160     8.7333      7.2878
10.MPG               3  119.00      121.00     119.67      1.1547
11.HC                3  .24000 -2  .13710     .51133 -1  .74671 -1
12.CO                3  .29000 -2 '.49310     .16630      .28302
14.NOX               3  .41000 -2  .24000 -1  .12167 -1  .10471 -1
16.METHANOL          1  .43150     .43150     .43150

DESCRIPTIVE MEASURES  <71> OXY:3*CAT:(#4)*TPRO:IDLE
   VARIABLE          N  MINIMUM    MAXIMUM      MEAN       STD DEV
 9.ALDY              2  4.0400      11.160     7.6000      5.0346
10.MPG               2  123.00      124.00     123.50      .70711
11.HC                2  .44000 -2  .81000 -2  .62500 -2  .26163 -2
12.CO                2  .10000 -3  .31000 -2  .16000 -2  .21213 -2
14.NOX               2  .10800 -1  .12300 -1  .11550 -1  .10607 -2
16.METHANOL          0

DESCRIPTIVE MEASURES  <72> OXY:5*CAT:(#4)*TPRO:IDLE
   VARIABLE          N  MINIMUM    MAXIMUM      MEAN       STD DEV
 9.ALDY              2  26.820      29.110     27.965      1.6193
10.MPG               2  116.00      121.00     118.50      3.5355
11.HC                2  .98000 -2  .16400 -1  .13100 -1  .46669 -2
12.CO                2  .26000 -2  .84000 -2  .55000 -2  .41012 -2
14.NOX               2  .82000 -2  .22400 -1  .15300 -1  .10041 -1
```

```
16.METHANOL          0

DESCRIPTIVE MEASURES   <73> OXY:0*CAT:(#5)*TPRO:IDLE
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
      9.ALDY           2  13.240      13.380       13.310      .98995 -1
     10.MPG            1  136.00      136.00       136.00
     11.HC             2  .80500 -1   .89700 -1   .85100 -1   .65054 -2
     12.CO             2  .36480      .41690      .39085      .36840 -1
     14.NOX            2  .23100 -1   .24400 -1   .23750 -1   .91924 -3
     16.METHANOL       0

DESCRIPTIVE MEASURES   <74> OXY:3*CAT:(#5)*TPRO:IDLE
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
      9.ALDY           0
     10.MPG            1  128.00      128.00       128.00
     11.HC             2  .99900 -1   .12220       .11105      .15768 -1
     12.CO             2  .40590      .45170       .42880      .32385 -1
     14.NOX            2  .24400 -1   .29900 -1   .27150 -1   .38891 -2
     16.METHANOL       0

DESCRIPTIVE MEASURES   <75> OXY:5*CAT:(#5)*TPRO:IDLE
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
      9.ALDY           0
     10.MPG            2  118.00      123.00       120.50      3.5355
     11.HC             2  .13370      .13650       .13510      .19799 -2
     12.CO             2  .60090      .64200       .62145      .29062 -1
     14.NOX            2  .43100 -1   .45600 -1   .44350 -1   .17678 -2
     16.METHANOL       0

DESCRIPTIVE MEASURES   <76> OXY:0*CAT:(#6)*TPRO:IDLE
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
      9.ALDY           0
```

```
  10.MPG             2  124.00     127.00      125.50      2.1213
  11.HC              2  .14360     .14730      .14545      .26163 -2
  12.CO              2  .53540     .62540      .58040      .63640 -1
  14.NOX             2  .26200 -1  .32900 -1   .29550 -1   .47376 -2
  16.METHANOL        0

DESCRIPTIVE MEASURES  <77> OXY:3*CAT:(#5)*TPRO:IDLE
    VARIABLE         N  MINIMUM    MAXIMUM      MEAN       STD DEV
   9.ALDY            0
  10.MPG             2  118.00     121.00      119.50      2.1213
  11.HC              2  .14010     .16110      .15060      .14849 -1
  12.CO              2  .59070     .82020      .70545      .16228
  14.NOX             2  .26400 -1  .27900 -1   .27150 -1   .10607 -2
  16.METHANOL        0

DESCRIPTIVE MEASURES  <78> OXY:5*CAT:(#6)*TPRO:IDLE
    VARIABLE         N  MINIMUM    MAXIMUM      MEAN       STD DEV
   9.ALDY            0
  10.MPG             2  112.00     118.00      115.00      4.2426
  11.HC              2  .15660     .17050      .16355      .98288 -2
  12.CO              2  .57110     .67460      .62285      .73186 -1
  14.NOX             2  .29600 -1  .30200 -1   .29900 -1   .42426 -3
  16.METHANOL        0

DESCRIPTIVE MEASURES  <79> OXY:0*CAT:(#7)*TPRO:IDLE
    VARIABLE         N  MINIMUM    MAXIMUM      MEAN       STD DEV
   9.ALDY            0
  10.MPG             3  109.00     127.00      120.00      9.6437
  11.HC              3  .15000 -2  .76600 -1   .35100 -1   .38168 -1
  12.CO              3  .67700 -1  .22430      .13843      .79389 -1
  14.NOX             3  .80000 -3  .12700 -1   .67000 -2   .59506 -2
  16.METHANOL        0
```

```
DESCRIPTIVE MEASURES  <80> OXY:3*CAT:(#7)*TPRO:IDLE
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY             0
 10.MPG              2  124.00      125.00      125.00       1.4142
 11.HC               2  .75000 -2   .11600 -1   .95500 -2   .28991 -2
 12.CO               2  .23000 -2   .83000 -2   .53000 -2   .42426 -2
 14.NOX              2  .15500 -1   .22900 -1   .19200 -1   .52326 -2
 16.METHANOL         0

DESCRIPTIVE MEASURES  <81> OXY:5*CAT:(#7)*TPRO:IDLE
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY             1  123.00      123.00      123.00
 10.MPG              2  119.00      123.00      121.00       2.8284
 11.HC               3  .20700 -1   .28700 -1   .24233 -1   .40808 -2
 12.CO               3  .10000 -3   .55000 -2   .28000 -2   .27000 -2
 14.NOX              3  .23500 -1   .27100 -1   .24967 -1   .18903 -2
 16.METHANOL         0

DESCRIPTIVE MEASURES  <82> OXY:0*CAT:(#8)*TPRO:IDLE
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY             0
 10.MPG              2  123.00      132.00      127.50       6.3640
 11.HC               2  .41500 -1   .66300 -1   .53900 -1   .17536 -1
 12.CO               2  .45560      .48890      .47225      .23547 -1
 14.NOX              2  .18700 -1   .19800 -1   .19250 -1   .77782 -3
 16.METHANOL         0

DESCRIPTIVE MEASURES  <83> OXY:3*CAT:(#8)*TPRO:IDLE
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY             0
 10.MPG              2  104.00      122.00      113.00       12.728
 11.HC               2  .53800 -1   .12590      .89850 -1   .50982 -1
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   12.CO                2  .72220      .84000      .78110      .83297 -1
   14.NOX               2  .16400 -1   .24100 -1   .20250 -1   .54447 -2
   16.METHANOL          0

DESCRIPTIVE MEASURES   <85> OXY:0*CAT:NONE*TPRO:IDLE
     VARIABLE           N  MINIMUM     MAXIMUM      MEAN       STD DEV
      9.ALDY            8  6.9800      24.120      15.922      6.0147
    10.MPG              7  109.00      146.00      129.14      13.120
    11.HC               8  .81500 -1   .15910      .10174      .26176 -1
    12.CO               8  .60210      1.0470      .74107      .14344
    14.NOX              8  .11500 -1   .45600 -1   .24200 -1   .11456 -1
    16.METHANOL         4  .18350      .24670      .21137      .28369 -1

DESCRIPTIVE MEASURES   <86> OXY:3*CAT:NONE*TPRO:IDLE
     VARIABLE           N  MINIMUM     MAXIMUM      MEAN       STD DEV
      9.ALDY            3  15.140      23.550      18.200      4.6492
    10.MPG              3  126.00      143.00      137.67      8.3865
    11.HC               3  .73400 -1   .87300 -1   .78900 -1   .73899 -2
    12.CO               3  .57550      .74970      .63777      .97142 -1
    14.NOX              3  .11200 -1   .15700 -1   .12700 -1   .25981 -2
    16.METHANOL         3  .19090      .27010      .22723      .40002 -1

DESCRIPTIVE MEASURES   <87> OXY:5*CAT:NONE*TPRO:IDLE
     VARIABLE           N  MINIMUM     MAXIMUM      MEAN       STD DEV
      9.ALDY            2  19.050      20.160      19.605      .78489
    10.MPG              2  120.00      121.00      120.50      .70711
    11.HC               2  .98100 -1   .99900 -1   .99000 -1   .12728 -2
    12.CO               2  .73560      .77020      .75290      .24466 -1
    14.NOX              2  .13900 -1   .15000 -1   .14450 -1   .77782 -3
    16.METHANOL         2  .29560      .30640      .30100      .76368 -2

DESCRIPTIVE MEASURES   <88> OXY:0*CAT:STOCK*TPRO:IDLE
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   VARIABLE          N  MINIMUM     MAXIMUM       MEAN     STD DEV
  9.ALDY             4  0.          .13000      .85000 -1  .58023 -1
 10.MPG              4  114.00      124.00      119.75     4.3493
 11.HC               4  .15000 -2  .53000 -2   .27000 -2  .17493 -2
 12.CO               4  .27000 -2  .10840      .29825 -1  .52397 -1
 14.NOX              4  0.          .17000 -2  .62500 -3  .80984 -3
 16.METHANOL         4  .70000 -3  .21000 -2   .15000 -2  .58878 -3

DESCRIPTIVE MEASURES   <91> UXY:0*CAT:(#1)*TPRO:SS10
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN     STD DEV
  9.ALDY             2  .20000      1.9000      1.0500     1.2021
 10.MPG              2  10.000      10.100      10.050     .70711 -1
 11.HC               2  .12000 -1  .28000 -1   .20000 -1  .11314 -1
 12.CO               2  0.          0.          0.
 14.NOX              2  .10000 -1  .45000 -1   .27500 -1  .24749 -1
 16.METHANOL         2  .80000 -2  .60000 -1   .34000 -1  .36770 -1

DESCRIPTIVE MEASURES   <92> UXY:3*CAT:(#1)*TPRO:SS10
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN     STD DEV
  9.ALDY             3  1.3000      11.700      5.9000     5.3028
 10.MPG              3  10.100      10.400      10.267     .15275
 11.HC               3  .22000 -1  .38000 -1   .28000 -1  .87178 -2
 12.CO               3  .16000 -1  .34000 -1   .27667 -1  .10116 -1
 14.NOX              3  .28400      .30100      .29000     .95394 -2
 16.METHANOL         3  .60000 -2  .90000 -2   .73333 -2  .15275 -2

DESCRIPTIVE MEASURES   <93> UXY:5*CAT:(#1)*TPRO:SS10
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN     STD DEV
  9.ALDY             3  1.8000      5.8000      3.7667     2.0008
 10.MPG              3  9.5000      10.100      9.9333     .28868
 11.HC               3  .19000 -1  .25000 -1   .23000 -1  .34641 -2
 12.CO               3  0.          .16000 -1  .53333 -2  .92376 -2
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   14.NOX               3  .24500     .33100     .30933     .19088 -1
   16.METHANOL          2  .70000 -2  .13000 -1  .10000 -1  .42426 -2

DESCRIPTIVE MEASURES  <94> UXY:0*CAT:(#2)*TPRO:5510

      VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

    9.ALDY              2  .20000     2.0000     1.1000      1.2728

   10.MPG               2  10.200     10.500     10.350     .21213

   11.HC                2  .20000 -1  .21000 -1  .20500 -1  .70711 -3

   12.CO                2  0.         0.         0.

   14.NOX               2  .19600     .26700     .23150     .50205 -1

   16.METHANOL          1  .16100     .16100     .16100

DESCRIPTIVE MEASURES  <96> UXY:5*CAT:(#2)*TPRO:5510

      VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

    9.ALDY              1  1.8000     1.8000     1.8000

   10.MPG               1  10.000     10.000     10.000

   11.HC                1  .23000 -1  .23000 -1  .23000 -1

   12.CO                1  .18000 -1  .18000 -1  .18000 -1

   14.NOX               1  .30400     .30400     .30400

   16.METHANOL          1  .22000 -1  .22000 -1  .22000 -1

DESCRIPTIVE MEASURES  <97> UXY:0*CAT:(#3)*TPRO:5510

      VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

    9.ALDY              0

   10.MPG               2  9.8000     10.200     10.000     .28284

   11.HC                2  .22000 -1  .40000 -1  .31000 -1  .12728 -1

   12.CO                2  .15400     .23500     .19450     .57276 -1

   14.NOX               2  .41000 -1  .45000 -1  .43000 -1  .28284 -2

   16.METHANOL          0

DESCRIPTIVE MEASURES  <98> UXY:3*CAT:(#3)*TPRO:5510

      VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
   9.ALDY             1  64.800      64.800      64.800
  10.MPG              3  9.6000      9.8000      9.7000       .10000
  11.HC               3  .25000 -1   .90000 -1   .51000 -1    .34395 -1
  12.CO               3  0.          .22200      .74333 -1    .12788
  14.NOX              3  .27900      .33400      .30867       .30006 -1
  16.METHANOL         1  .36000 -1   .36000 -1   .36000 -1

DESCRIPTIVE MEASURES  <99> OXY:5*CAT:(#3)*TPRO:SS10
     VARIABLE         N  MINIMUM     MAXIMUM        MEAN      STD DEV
   9.ALDY             2  293.06      294.49      293.77       1.0112
  10.MPG              1  9.8000      9.8000      9.8000
  11.HC               2  .10200      1.0000      .55100       .63498
  12.CO               2  .10000 -2   1.0000      .50050       .70640
  14.NOX              1  .25800      .25800      .25800
  16.METHANOL         0

DESCRIPTIVE MEASURES  <100> OXY:0*CAT:(#4)*TPRO:SS10
     VARIABLE         N  MINIMUM     MAXIMUM        MEAN      STD DEV
   9.ALDY             3  2.1300      41.530      26.237       21.127
  10.MPG              3  9.7000      9.8000      9.7667       .57735 -1
  11.HC               3  .33000 -1   .17600      .10400       .71505 -1
  12.CO               3  1.6440      3.5690      2.8907       1.0810
  14.NOX              3  .50000 -2   .41000 -1   .25333 -1    .18448 -1
  16.METHANOL         1  .51700      .51700      .51700

DESCRIPTIVE MEASURES  <101> OXY:3*CAT:(#4)*TPRO:SS10
     VARIABLE         N  MINIMUM     MAXIMUM        MEAN      STD DEV
   9.ALDY             2  28.400      44.000      36.200       11.031
  10.MPG              2  9.7000      10.200      9.9500       .35355
  11.HC               2  .43000 -1   .43000 -1   .43000 -1
  12.CO               2  .20000 -2   .36000 -1   .19000 -1    .24042 -1
  14.NOX              2  .24300      .26300      .25300       .14142 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES   <102> OXY:5*CAT:(#4)*TPRO:SS10
     VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
   9.ALDY              2  81.200       134.50       107.85       37.689
  10.MPG               2  9.6000       9.7000       9.6500       .70711 -1
  11.HC                2  .36000 -1   .61000 -1   .48500 -1   .17678 -1
  12.CO                2  .30000 -2   .21000 -1   .12000 -1   .12728 -1
  14.NOX               2  .23700       .26000       .24850       .16263 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES   <103> OXY:0*CAT:(#5)*TPRO:SS10
     VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
   9.ALDY              2  69.300       82.050       75.675       9.0156
  10.MPG               1  10.300       10.300       10.300
  11.HC                2  .26100       .30300       .28200       .29698 -1
  12.CO                2  4.9160       5.3980       5.1570       .34083
  14.NOX               2  .28600       .29600       .29100       .70711 -2
  16.METHANOL          0

DESCRIPTIVE MEASURES   <104> OXY:3*CAT:(#5)*TPRO:SS10
     VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
   9.ALDY              0
  10.MPG               1  10.100       10.100       10.100
  11.HC                2  .28700       .37600       .33150       .62933 -1
  12.CO                2  5.0180       5.2860       5.1520       .18950
  14.NOX               2  .28600       .32300       .30450       .26163 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES   <105> OXY:5*CAT:(#5)*TPRO:SS10
     VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
   9.ALDY              0
  10.MPG              2  9.9000     10.100     10.000     .14142
  11.HC               2  .53100     .54900     .54000     .12728 -1
  12.CO               2  8.4050     9.7530     9.0790     .95318
  14.NOX              2  .32900     .34100     .33500     .84853 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <106> OXY:0*CAT:(#6)*TPRO:SS10
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV
   9.ALDY             0
  10.MPG              2  10.100     10.100     10.100
  11.HC               2  .62800     .67100     .64950     .30406 -1
  12.CO               2  7.6250     7.9890     7.8070     .25739
  14.NOX              2  .30500     .30800     .30650     .21213 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <107> OXY:3*CAT:(#6)*TPRO:SS10
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV
   9.ALDY             0
  10.MPG              2  10.000     10.100     10.050     .70711 -1
  11.HC               2  .54300     .57500     .55900     .22627 -1
  12.CO               2  7.6760     8.6520     8.1640     .69014
  14.NOX              2  .29300     .30100     .29700     .56569 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <108> OXY:5*CAT:(#6)*TPRO:SS10
    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV
   9.ALDY             0
  10.MPG              2  9.9000     10.100     10.000     .14142
  11.HC               2  .60800     .67700     .64250     .48790 -1
  12.CO               2  8.0840     8.2080     8.1460     .87681 -1
  14.NOX              2  .30700     .32200     .31450     .10607 -1
  16.METHANOL         0
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DESCRIPTIVE MEASURES  <109> OXY:0*CAT:(#7)*TPRO:SS10
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              3  10.100      10.100      10.100
  11.HC               3  .39000 -1   .20500      .16800      .11635
  12.CO               3  2.0140      2.4290      2.2187      .20756
  14.NOX              3  .10000 -1   .46000 -1   .33667 -1   .20502 -1
  16.METHANOL         0

DESCRIPTIVE MEASURES  <110> OXY:3*CAT:(#7)*TPRO:SS10
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              2  10.000      10.100      10.050      .70711 -1
  11.HC               2  .71000 -1   .74000 -1   .72500 -1   .21213 -2
  12.CO               2  .21000 -1   .35000 -1   .28[illegible] -1   .98995 -2
  14.NOX              2  .27900      .28100      .28000      .14142 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <111> OXY:5*CAT:(#7)*TPRO:SS10
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             1  10.100      10.100      10.100
  10.MPG              2  9.9000      10.100      10.000      .14142
  11.HC               3  .10600      .11200      .10900      .30000 -2
  12.CO               3  .18000 -1   .60000 -1   .45000 -1   .24556 -1
  14.NOX              3  .27100      .27600      .27400      .25456 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <112> OXY:0*CAT:(#8)*TPRO:SS10
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              2  9.9000      10.200      10.050      .21213
  11.HC               2  .19700      .29000      .24350      .65761 -1
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   12.CO              2  6.4910     6.8390     6.6650     .24607
   14.NOX             2  .29200     .29800     .29500     .42426 -2
   16.METHANOL        0

DESCRIPTIVE MEASURES  <113> OXY:3*CAT:(#8)*TPRO:SS10
     VARIABLE        N  MINIMUM    MAXIMUM       MEAN     STD DEV
    9.ALDY            0
   10.MPG             2  9.8000     10.100     9.9500     .21213
   11.HC              2  .21600     .54800     .36200     .23476
   12.CO              2  9.2610     9.6010     9.4310     .24042
   14.NOX             2  .25100     .36700     .30900     .82024 -1
   16.METHANOL        0

DESCRIPTIVE MEASURES  <115> OXY:0*CAT:NONE*TPRO:SS10
     VARIABLE        N  MINIMUM    MAXIMUM       MEAN     STD DEV
    9.ALDY            5  106.85     226.62     144.65     49.194
   10.MPG             4  9.9000     10.200     10.000     .14142
   11.HC              5  .39600     .60200     .47720     .65473 -1
   12.CO              5  .40800     9.7060     3.0750     3.9074
   14.NOX             5  .26100     .36500     .31820     .39417 -1
   16.METHANOL        1  1.0460     1.0460     1.0460

DESCRIPTIVE MEASURES  <121> OXY:0*CAT:(#1)*TPRO:SS20
     VARIABLE        N  MINIMUM    MAXIMUM       MEAN     STD DEV
    9.ALDY            2  .70000     2.2000     1.4500     1.0607
   10.MPG             2  19.600     19.800     19.700     .14142
   11.HC              2  .50000 -2  .11000 -1  .80000 -2  .42426 -2
   12.CO              2  .80000 -2  .25000 -1  .16500 -1  .12021 -1
   14.NOX             2  .80000 -2  .53000 -1  .30500 -1  .31820 -1
   16.METHANOL        2  .16000 -1  .22000 -1  .19000 -1  .42426 -2

DESCRIPTIVE MEASURES  <122> OXY:3*CAT:(#1)*TPRO:SS20
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     VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             2  1.0000      2.6000       1.8000      1.1314
    10.MPG              3  19.400      19.900       19.567      .20817
    11.HC               3  .10000 -1   .39000 -1   .20000 -1   .16462 -1
    12.CO               3  0.          .27900       .93333 -1   .16079
    14.NOX              3  .41300      .54000       .47767      .63532 -1
    16.METHANOL         3  .40000 -2   .36000 -1   .15000 -1   .19193 -1

DESCRIPTIVE MEASURES  <123> OXY:5*CAT:(#1)*TPRO:SS20
     VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             2  1.1000      1.6000       1.3500      .35355
    10.MPG              2  19.400      19.400       19.400
    11.HC               2  .70000 -2   .80000 -2   .75000 -2   .70711 -3
    12.CO               2  0.          0.           0.
    14.NOX              2  .44800      .49200       .47000      .31113 -1
    16.METHANOL         1  .20000 -2   .20000 -2   .20000 -2

DESCRIPTIVE MEASURES  <124> OXY:0*CAT:(#2)*TPRO:SS20
     VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             2  .80000      1.5000       1.1500      .49497
    10.MPG              2  19.600      20.300       19.950      .49497
    11.HC               2  .80000 -2   .10000 -1   .90000 -2   .14142 -2
    12.CO               2  0.          0.           0.
    14.NOX              2  .13300      .41300       .27300      .19799
    16.METHANOL         1  .39000 -1   .39000 -1   .39000 -1

DESCRIPTIVE MEASURES  <125> OXY:5*CAT:(#2)*TPRO:SS20
     VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
     9.ALDY             1  1.5000      1.5000       1.5000
    10.MPG              1  19.400      19.400       19.400
    11.HC               1  .10000 -1   .10000 -1   .10000 -1
    12.CO               1  .90000 -2   .90000 -2   .90000 -2
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  14.NOX              1  .47100      .47100      .47100

  16.METHANOL         1  .10100      .10100      .10100

DESCRIPTIVE MEASURES  <127> OXY:0*CAT:(#3)*TPRO:SS20

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

   9.ALDY             0

  10.MPG              2  18.900      19.000      18.950      .70711 -1

  11.HC               2  .11000 -1   .30000 -1   .20500 -1   .13435 -1

  12.CO               2  .45100      .60400      .52750      .10819

  14.NOX              2  .51000 -1   .56000 -1   .53500 -1   .35355 -2

  16.METHANOL         0

DESCRIPTIVE MEASURES  <128> OXY:3*CAT:(#3)*TPRO:SS20

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

   9.ALDY             1  70.580      70.580      70.580

  10.MPG              3  18.400      19.200      18.800      .40000

  11.HC               3  .12000 -1   .29000 -1   .19667 -1   .86217 -2

  12.CO               3  0.          0.          0.

  14.NOX              3  .43000      .53800      .48167      .54151 -1

  16.METHANOL         2  .47000 -1   .55000 -1   .51000 -1   .56569 -2

DESCRIPTIVE MEASURES  <129> OXY:5*CAT:(#3)*TPRO:SS20

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

   9.ALDY             2  144.94      165.52      155.23      14.552

  10.MPG              2  17.700      19.100      18.400      .98995

  11.HC               2  .97000 -1   .17400      .13550      .54447 -1

  12.CO               2  .90000 -2   .30900      .15900      .21213

  14.NOX              2  .38000      .42300      .40150      .30406 -1

  16.METHANOL         0

DESCRIPTIVE MEASURES  <130> OXY:0*CAT:(#4)*TPRO:SS20

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            2  19.830      20.800      20.315      .68589
 10.MPG             2  17.900      18.100      18.000      .14142
 11.HC              2  .12000      .13400      .12700      .98995 -2
 12.CO              2  1.2760      1.6150      1.4455      .23971
 14.NOX             2  .37000 -1   .52000 -1   .44500 -1   .10607 -1
 16.METHANOL        1  .32200      .32200      .32200

DESCRIPTIVE MEASURES  <131> OXY:3*CAT:(#4)*TPRO:SS20
   VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            2  91.500      113.60      102.55      15.627
 10.MPG             2  18.500      18.900      18.700      .28284
 11.HC              2  .39000 -1   .55000 -1   .47000 -1   .11314 -1
 12.CO              2  .90000 -2   .18000 -1   .13500 -1   .63640 -2
 14.NOX             2  .38900      .45900      .42400      .49497 -1
 16.METHANOL        0

DESCRIPTIVE MEASURES  <132> OXY:5*CAT:(#4)*TPRO:SS20
   VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            1  138.90      138.90      138.90
 10.MPG             1  18.600      18.600      18.600
 11.HC              1  .39000 -1   .39000 -1   .39000 -1
 12.CO              1  .18000 -1   .18000 -1   .18000 -1
 14.NOX             1  .37400      .37400      .37400
 16.METHANOL        0

DESCRIPTIVE MEASURES  <133> OXY:0*CAT:(#5)*TPRO:SS20
   VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            1  61.380      61.380      61.380
 10.MPG             1  19.500      19.500      19.500
 11.HC              1  .29500      .29500      .29500
 12.CO              1  3.0950      3.0950      3.0950
 14.NOX             1  .45200      .45200      .45200
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  16.METHANOL          0

DESCRIPTIVE MEASURES   <134> OXY:3*CAT:(#5)*TPRO:SS20
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               1  18.900      18.900      18.900
  11.HC                1  .42800      .42800      .42800
  12.CO                1  4.1710      4.1710      4.1710
  14.NOX               1  .52800      .52800      .52800
  16.METHANOL          0

DESCRIPTIVE MEASURES   <135> OXY:5*CAT:(#5)*TPRO:SS20
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               2  18.400      19.700      19.050      .91924
  11.HC                2  .41000      .46100      .43550      .36062 -1
  12.CO                2  4.1170      4.4760      4.2965      .25385
  14.NOX               2  .40900      .44500      .42700      .25456 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES   <136> OXY:0*CAT:(#6)*TPRO:SS20
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               2  18.700      19.300      19.000      .42426
  11.HC                2  .54500      .59600      .57050      .36062 -1
  12.CO                2  4.1970      4.2260      4.2115      .20506 -1
  14.NOX               2  .50700      .51500      .51100      .56569 -2
  16.METHANOL          0

DESCRIPTIVE MEASURES   <137> OXY:3*CAT:(#5)*TPRO:SS20
     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
   10.MPG                 2  18.800     19.100     18.950     .21213
   11.HC                  2  .50000     .54200     .52100     .29698 -1
   12.CO                  2  3.6650     4.4530     4.0590     .55720
   14.NOX                 2  .47800     .55000     .51400     .50912 -1
   16.METHANOL            0

DESCRIPTIVE MEASURES   <138> OXY:5*CAT:(#6)*TPRO:SS20
     VARIABLE             N  MINIMUM    MAXIMUM    MEAN       STD DEV
    9.ALDY                0
   10.MPG                 2  19.100     19.400     19.250     .21213
   11.HC                  2  .44400     .47000     .45700     .18385 -1
   12.CO                  2  3.6620     3.8080     3.7350     .10324
   14.NOX                 2  .42000     .48800     .45400     .48083 -1
   16.METHANOL            0

DESCRIPTIVE MEASURES   <139> OXY:0*CAT:(#7)*TPRO:SS20
     VARIABLE             N  MINIMUM    MAXIMUM    MEAN       STD DEV
    9.ALDY                0
   10.MPG                 3  18.900     19.400     19.100     .26458
   11.HC                  3  .32000 -1  .16800     .87333 -1  .71452 -1
   12.CO                  3  .42600     1.2110     .85400     .39729
   14.NOX                 3  .23000 -1  .12400     .57333 -1  .57744 -1
   16.METHANOL            0

DESCRIPTIVE MEASURES   <140> OXY:3*CAT:(#7)*TPRO:SS20
     VARIABLE             N  MINIMUM    MAXIMUM    MEAN       STD DEV
    9.ALDY                0
   10.MPG                 2  18.900     19.400     19.150     .35355
   11.HC                  2  .74000 -1  .11800     .96000 -1  .31113 -1
   12.CO                  2  .18000 -1  .58000 -1  .38000 -1  .28284 -1
   14.NOX                 2  .34800     .38400     .36600     .25456 -1
   16.METHANOL            0
```

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DESCRIPTIVE MEASURES  <141> OXY:5*CAT:(#7)*TPHO:SS20
    VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               3  19.000      19.600      19.300      .30000
  11.HC                3  .36000 -1   .12800      .85000 -1   .46293 -1
  12.CO                3  .10000 -2   .90000 -2   .60000 -2   .43589 -2
  14.NOX               3  .36800      .44200      .40667      .37112 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES  <142> OXY:0*CAT:(#8)*TPHO:SS20
    VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               2  18.400      19.500      18.950      .77782
  11.HC                2  .28500      .32300      .30400      .26870 -1
  12.CO                2  3.4010      3.4240      3.4125      .16263 -1
  14.NOX               2  .42600      .42600      .42600
  16.METHANOL          0

DESCRIPTIVE MEASURES  <143> OXY:3*CAT:(#8)*TPHO:SS20
    VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              0
  10.MPG               2  18.800      19.400      19.100      .42426
  11.HC                2  .19800      .30900      .25350      .78489 -1
  12.CO                2  4.1990      4.3190      4.2590      .84853 -1
  14.NOX               2  .31700      .33400      .32550      .12021 -1
  16.METHANOL          0

DESCRIPTIVE MEASURES  <145> OXY:0*CAT:NONE*TPHO:SS20
    VARIABLE           N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY              8  73.740      165.45      126.96      39.281
  10.MPG               7  19.100      21.100      19.557      .69727
  11.HC                8  .34300      .47700      .39612      .38200 -1
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   12.CO             8  4.2110      6.4590      4.7681      .73652
   14.NOX            8  .47500      .57900      .50537      .36300 -1
   16.METHANOL       4  .85400      1.2190      .98075      .16778

DESCRIPTIVE MEASURES  <146> OXY:3*CAT:NONE*TPRO:SS20
      VARIABLE       N  MINIMUM     MAXIMUM       MEAN      STD DEV
    9.ALDY           3  84.800      151.20      123.27      34.430
   10.MPG            3  19.400      19.900      19.633      .25166
   11.HC             3  .33400      .34800      .33867      .80829 -2
   12.CO             3  3.8130      4.3120      4.0593      .24956
   14.NOX            3  .44200      .49600      .47033      .27099 -1
   16.METHANOL       3  .82600      1.2980      1.0453      .23776

DESCRIPTIVE MEASURES  <147> OXY:5*CAT:NONE*TPRO:SS20
      VARIABLE       N  MINIMUM     MAXIMUM       MEAN      STD DEV
    9.ALDY           2  104.20      105.90      105.05      1.2021
   10.MPG            2  18.900      19.100      19.000      .14142
   11.HC             2  .32600      .34400      .33500      .12728 -1
   12.CO             2  4.3070      4.4250      4.3660      .83439 -1
   14.NOX            2  .42700      .43700      .43200      .70711 -2
   16.METHANOL       2  1.0840      1.2980      1.1910      .15132

DESCRIPTIVE MEASURES  <148> OXY:0*CAT:STOCK*TPRO:SS20
      VARIABLE       N  MINIMUM     MAXIMUM       MEAN      STD DEV
    9.ALDY           4  .20000      .30000      .22500      .50000 -1
   10.MPG            4  18.900      19.800      19.375      .36856
   11.HC             4  .50000 -2  .10000 -1  .70000 -2  .24495 -2
   12.CO             4  .16000 -1  .15000      .49750 -1  .66835 -1
   14.NOX            4  0.          .50000 -2  .12500 -2  .25000 -2
   16.METHANOL       4  .10000 -2  .50000 -2  .27500 -2  .17078 -2

DESCRIPTIVE MEASURES  <151> OXY:0*CAT:(#1)*TPRO:SS30
```

```
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            2  .30000      .40000       .35000      .70711 -1
  10.MPG             2  21.500      21.600       21.550      .70711 -1
  11.HC              2  .20000 -2   .30000 -2    .25000 -2   .70711 -3
  12.CO              2  .17000 -1   .28000 -1    .22500 -1   .77782 -2
  14.NOX             2  .20000 -2   .50000 -2    .35000 -2   .21213 -2
  16.METHANOL        2  .20000 -2   .80000 -2    .50000 -2   .42426 -2

DESCRIPTIVE MEASURES  <152> OXY:3*CAT:(#1)*TPRO:SS30
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            3  .40000      3.0000       2.2000      1.1358
  10.MPG             3  21.200      21.600       21.433      .20817
  11.HC              3  .80000 -2   .90000 -2    .83333 -2   .57735 -3
  12.CO              3  0.          .10000 -2    .33333 -3   .57735 -3
  14.NOX             3  1.1400      1.2150       1.1883      .41932 -1
  16.METHANOL        3  .20000 -2   .50000 -2    .36667 -2   .15275 -2

DESCRIPTIVE MEASURES  <153> OXY:5*CAT:(#1)*TPRO:SS30
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            2  .60000      2.2000       1.4000      1.1314
  10.MPG             2  21.200      21.400       21.300      .14142
  11.HC              2  .80000 -2   .80000 -2    .80000 -2
  12.CO              2  0.          0.           0.
  14.NOX             2  1.1740      1.2620       1.2180      .62225 -1
  16.METHANOL        1  .30000 -2   .30000 -2    .30000 -2

DESCRIPTIVE MEASURES  <154> OXY:0*CAT:(#2)*TPRO:SS30
   VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            2  .50000      6.7000       3.6000      4.3841
  10.MPG             2  21.000      21.700       21.350      .49497
  11.HC              2  .60000 -2   .70000 -2    .65000 -2   .70711 -3
  12.CO              2  0.          .23000 -1    .11500 -1   .16263 -1
```

```
   14.NOX               2  .39500       .56200       .47850       .11809
   16.METHANOL          1  .24000 -1   .24000 -1   .24000 -1

DESCRIPTIVE MEASURES   <156> OXY:5*CAT:(#2)*TPRO:SS30
      VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
    9.ALDY              1  5.6000       5.6000       5.6000
   10.MPG               1  20.300       20.300       20.300
   11.HC                1  .10000 -1   .10000 -1   .10000 -1
   12.CO                1  .29000 -1   .29000 -1   .29000 -1
   14.NOX               1  1.2180       1.2180       1.2180
   16.METHANOL          1  .52000 -1   .52000 -1   .52000 -1

DESCRIPTIVE MEASURES   <157> OXY:0*CAT:(#3)*TPRO:SS30
      VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
    9.ALDY              0
   10.MPG               2  20.200       21.000       20.600       .56569
   11.HC                2  .60000 -2   .13000 -1   .95000 -2   .49497 -2
   12.CO                2  .18900       .25000       .21950       .43134 -1
   14.NOX               2  .27000 -1   .61000 -1   .44000 -1   .24042 -1
   16.METHANOL          0

DESCRIPTIVE MEASURES   <158> OXY:3*CAT:(#3)*TPRO:SS30
      VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
    9.ALDY              1  70.740       70.740       70.740
   10.MPG               3  19.400       20.200       19.867       .41633
   11.HC                3  .17000 -1   .58000 -1   .36000 -1   .20664 -1
   12.CO                3  0.           .34000 -1   .13333 -1   .18148 -1
   14.NOX               3  1.1940       1.2770       1.2300       .42579 -1
   16.METHANOL          2  .42000 -1   .16800       .10500       .89095 -1

DESCRIPTIVE MEASURES   <159> OXY:5*CAT:(#3)*TPRO:SS30
      VARIABLE          N  MINIMUM      MAXIMUM        MEAN       STD DEV
```

```
 9.ALDY            2  98.950      114.98       106.96      11.335
10.MPG             2  19.600      20.800       20.200      .84853
11.HC              2  .24000 -1   .10000       .62000 -1   .53740 -1
12.CO              2  .60000 -2   .12300       .64500 -1   .82731 -1
14.NOX             2  1.0880      1.2240       1.1560      .96167 -1
16.METHANOL        0

DESCRIPTIVE MEASURES  <160> OXY:0*CAT:(#4)*TPRO:SS30
    VARIABLE       N  MINIMUM     MAXIMUM      MEAN        STD DEV
 9.ALDY            2  3.2800      3.7800       3.5300      .35355
10.MPG             2  20.200      20.400       20.300      .14142
11.HC              2  .13000 -1   .14000 -1    .13500 -1   .70711 -3
12.CO              2  .47500      .62700       .55100      .10748
14.NOX             2  .50000 -2   .10000 -1    .75000 -2   .35355 -2
16.METHANOL        1  .36000 -1   .36000 -1    .36000 -1

DESCRIPTIVE MEASURES  <161> OXY:3*CAT:(#4)*TPRO:SS30
    VARIABLE       N  MINIMUM     MAXIMUM      MEAN        STD DEV
 9.ALDY            2  14.800      21.600       18.200      4.8083
10.MPG             2  20.400      20.700       20.550      .21213
11.HC              2  .90000 -2   .10000 -1    .95000 -2   .70711 -3
12.CO              2  .60000 -2   .60000 -2    .60000 -2
14.NOX             2  1.0260      1.0830       1.0545      .40305 -1
16.METHANOL        0

DESCRIPTIVE MEASURES  <162> OXY:5*CAT:(#4)*TPRO:SS30
    VARIABLE       N  MINIMUM     MAXIMUM      MEAN        STD DEV
 9.ALDY            1  22.900      22.900       22.900
10.MPG             1  20.700      20.700       20.700
11.HC              1  .11000 -1   .11000 -1    .11000 -1
12.CO              1  .70000 -2   .70000 -2    .70000 -2
14.NOX             1  1.0730      1.0730       1.0730
```

```
   16.METHANOL          0

DESCRIPTIVE MEASURES   <163> OXY:0*CAT:(#5)*TPRO:SS30
      VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV
    9.ALDY              1  36.050      36.050      36.050
   10.MPG               1  21.500      21.500      21.500
   11.HC                1  .66000 -1   .66000 -1   .66000 -1
   12.CO                1  2.1990      2.1990      2.1990
   14.NOX               1  1.1040      1.1040      1.1040
   16.METHANOL          0

DESCRIPTIVE MEASURES   <164> OXY:3*CAT:(#5)*TPRO:SS30
      VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV
    9.ALDY              0
   10.MPG               1  21.200      21.200      21.200
   11.HC                1  .13700      .13700      .13700
   12.CO                1  3.9770      3.9770      3.9770
   14.NOX               1  1.0670      1.0670      1.0670
   16.METHANOL          0

DESCRIPTIVE MEASURES   <165> OXY:5*CAT:(#5)*TPRO:SS30
      VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV
    9.ALDY              0
   10.MPG               2  20.900      21.500      21.200      .42426
   11.HC                2  .25200      .25800      .25500      .42426 -2
   12.CO                2  4.4700      4.5760      4.5230      .74953 -1
   14.NOX               2  1.0560      1.0940      1.0750      .26870 -1
   16.METHANOL          0

DESCRIPTIVE MEASURES   <166> OXY:0*CAT:(#6)*TPRO:SS30
      VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV
    9.ALDY              0
```

```
 10.MPG             2  20.900      21.200      21.050      .21213
 11.HC              2  .39400      .40300      .39850      .63640 -2
 12.CO              2  4.8710      5.2200      5.0455      .24678
 14.NOX             2  1.1130      1.1190      1.1160      .42426 -2
 16.METHANOL        0

DESCRIPTIVE MEASURES  <167> OXY:3*CAT:(#6)*TPRO:SS30
    VARIABLE        N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            0
 10.MPG             2  20.800      21.000      20.900      .14142
 11.HC              2  .40800      .41200      .41000      .28284 -2
 12.CO              2  4.3420      5.0560      4.6990      .50487
 14.NOX             2  1.1070      1.1190      1.1130      .84853 -2
 16.METHANOL        0

DESCRIPTIVE MEASURES  <168> OXY:5*CAT:(#6)*TPRO:SS30
    VARIABLE        N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            0
 10.MPG             2  20.500      21.300      20.900      .56569
 11.HC              2  .28800      .37500      .33150      .61518 -1
 12.CO              2  3.4560      4.3700      3.9130      .64630
 14.NOX             2  .81600      1.1130      .96450      .21001
 16.METHANOL        0

DESCRIPTIVE MEASURES  <169> OXY:0*CAT:(#7)*TPRO:SS30
    VARIABLE        N  MINIMUM     MAXIMUM       MEAN      STD DEV
  9.ALDY            0
 10.MPG             3  20.700      20.900      20.800      .10000
 11.HC              3  .90000 -2  .18000 -1  .13000 -1  .45826 -2
 12.CO              3  .88200      1.3320      1.1260      .24031
 14.NOX             3  .10000 -1  .30000 -1  .18333 -1  .10408 -1
 16.METHANOL        0
```

```
DESCRIPTIVE MEASURES  <170> OXY:3*CAT:(#7)*TPRO:SS30
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              2  21.000      21.400      21.200      .28284
  11.HC               2  .80000 -2   .90000 -2   .85000 -2   .70711 -3
  12.CO               2  0.          .70000 -2   .35000 -2   .49497 -2
  14.NOX              2  1.0120      1.0180      1.0150      .42426 -2
  16.METHANOL         0

DESCRIPTIVE MEASURES  <171> OXY:5*CAT:(#7)*TPRO:SS30
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              3  21.000      21.400      21.167      .20817
  11.HC               3  .90000 -2   .90000 -2   .90000 -2
  12.CO               3  0.          .11000 -1   .56667 -2   .55076 -2
  14.NOX              3  1.0180      1.1110      1.0677      .46822 -1
  16.METHANOL         0

DESCRIPTIVE MEASURES  <172> OXY:0*CAT:(#8)*TPRO:SS30
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              2  20.900      21.900      21.400      .70711
  11.HC               2  .22100      .23300      .22700      .84853 -2
  12.CO               2  4.0860      4.0900      4.0880      .28284 -2
  14.NOX              2  .97100      1.1080      1.0395      .96874 -1
  16.METHANOL         0

DESCRIPTIVE MEASURES  <173> OXY:3*CAT:(#8)*TPRO:SS30
    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY             0
  10.MPG              2  21.900      22.000      21.950      .70711 -1
  11.HC               2  .12100      .13400      .12750      .91924 -2
  12.CO              2  4.3830      4.8980      4.6405      .36416
  14.NOX             2  .90800      .96700      .93750      .41719 -1
  16.METHANOL        0

DESCRIPTIVE MEASURES   <175> OXY:0*CAT:NONE*TPRO:SS30
    VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            8  72.280      169.30      126.84      34.830
  10.MPG             7  19.800      21.400      20.900      .59442
  11.HC              8  .33600      .41500      .36062      .27396 -1
  12.CO              8  4.2650      6.0040      4.8452      .59097
  14.NOX             8  1.0880      1.3060      1.2115      .74517 -1
  16.METHANOL        4  .77300      .87700      .83275      .61429 -1

DESCRIPTIVE MEASURES   <176> OXY:3*CAT:NONE*TPRO:SS30
    VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            3  104.00      142.10      129.13      21.770
  10.MPG             3  20.600      21.800      21.300      .62450
  11.HC              3  .31400      .33600      .32567      .11060 -1
  12.CO              3  4.1220      4.2960      4.2007      .88189 -1
  14.NOX             3  1.1470      1.2420      1.1963      .47605 -1
  16.METHANOL        3  .84800      .92400      .88967      .38527 -1

DESCRIPTIVE MEASURES   <177> OXY:5*CAT:NONE*TPRO:SS30
    VARIABLE         N  MINIMUM     MAXIMUM       MEAN      STD DEV
   9.ALDY            3  107.10      130.60      115.30      13.262
  10.MPG             3  21.000      21.200      21.133      .11547
  11.HC              3  .31900      .32300      .32100      .20000 -2
  12.CO              3  4.2010      4.5190      4.3890      .16675
  14.NOX             3  1.1580      1.2110      1.1810      .27185 -1
  16.METHANOL        3  .89800      .93000      .91267      .16166 -1

DESCRIPTIVE MEASURES   <178> OXY:0*CAT:STOCK*TPRO:SS30
```

```
   VARIABLE           N  MINIMUM      MAXIMUM        MEAN        STD DEV
  9.ALDY              4  .40000       2.6000        1.7500        1.0755
 10.MPG               4  20.900       21.700        21.350        .41231
 11.HC                4  .40000 -2   .60000 -2    .52500 -2    .95743 -3
 12.CO                4  .57000 -1   .69000 -1    .61500 -1    .54467 -2
 14.NOX               4  0.           .70000 -2    .22500 -2    .33040 -2
 16.METHANOL          4  .10000 -2   .90000 -2    .55000 -2    .41231 -2

DESCRIPTIVE MEASURES  <205> OXY:0*CAT:NONE*TPRO:SS40
   VARIABLE           N  MINIMUM      MAXIMUM        MEAN        STD DEV
  9.ALDY              2  166.30       170.50        168.40        2.9698
 10.MPG               2  19.500       21.600        20.550        1.4849
 11.HC                2  .30900       .32900        .31900        .14142 -1
 12.CO                2  3.8130       4.0760        3.9445        .18597
 14.NOX               2  1.5830       1.6980        1.6405        .81317 -1
 16.METHANOL          2  .72200       .92600        .82400        .14425

DESCRIPTIVE MEASURES  <206> OXY:3*CAT:NONE*TPRO:SS40
   VARIABLE           N  MINIMUM      MAXIMUM        MEAN        STD DEV
  9.ALDY              2  119.90       150.90        135.40        21.920
 10.MPG               3  19.800       20.600        20.167        .40415
 11.HC                3  .28900       .29900        .29267        .55076 -2
 12.CO                3  3.8650       4.2450        4.0640        .19064
 14.NOX               3  1.6010       1.6930        1.6443        .46231 -1
 16.METHANOL          3  .77400       .94700        .84967        .88512 -1

DESCRIPTIVE MEASURES  <207> OXY:5*CAT:NONE*TPRO:SS40
   VARIABLE           N  MINIMUM      MAXIMUM        MEAN        STD DEV
  9.ALDY              3  113.50       119.60        116.83        3.0892
 10.MPG               3  19.400       20.200        19.667        .41633
 11.HC                3  .28300       .30700        .29367        .12220 -1
 12.CO                3  3.8950       4.0740        3.9743        .89946 -1
 14.NOX             3  1.6270     1.7610     1.6943      .67002 -1
 16.METHANOL        3  .74300     .84100     .80767      .75745 -1

DESCRIPTIVE MEASURES  <208> OXY:0*CAT:STOCK*TPRO:SS40
    VARIABLE        N  MINIMUM    MAXIMUM     MEAN       STD DEV
   9.ALDY           4  0.         .64000     .42000      .28612
 10.MPG             4  20.000     21.500     20.775      .61305
 11.HC              4  .10000 -2  .30000 -2  .20000 -2  .81650 -3
 12.CO              4  0.         .36000 -1  .20000 -1  .15663 -1
 14.NOX             4  .15000 -1  .25600     .69500 -1  .11220
 16.METHANOL        4  .10000 -2  .20000 -2  .15000 -2  .57735 -3
```

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0255---------------690255---------------690255---------------690255---------------690255---------------690255-------

HER 690255      UNIVERSITY OF MICHIGAN TERMINAL SYSTEM  (MODEL AR173)        13:05:54 EDT      WED MAY 11/83
```

Meth, Cat Report NMIC Statistics

Interim

SAVE

```
MMMMM                    MMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT           SSSSSSSSS
MMMMMM                  MMMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT         SSSSSSSSSSSSS
MMMMMMM                MMMMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT       SSSSSSSSSSSSSSSSSS
MMMMMMMM              MMMMMMMM               TTTTT                SSSSSS       SSSSSSS
MMMMMMMMM            MMMMMMMMM               TTTTT               SSSSS           SSSSS
MMMMMMMMMM          MMMMMMMMMM               TTTTT               SSSSS
MMMMM MMMMM        MMMMM MMMMM               TTTTT                SSSSSS
MMMMM  MMMMM      MMMMM  MMMMM               TTTTT                 SSSSSSSSSSSSS
MMMMM   MMMMM    MMMMM   MMMMM               TTTTT                   SSSSSSSSSSSSS
MMMMM    MMMMMMMMMMMM    MMMMM               TTTTT                     SSSSSSSSSSSSS
MMMMM     MMMMMMMMMM     MMMMM               TTTTT                             SSSSSSS
MMMMM      MMMMMMMM      MMMMM               TTTTT                               SSSSS
MMMMM       MMMMMM       MMMMM               TTTTT                               SSSSS
MMMMM         MMM        MMMMM               TTTTT               SSSSS           SSSSS
MMMMM                    MMMMM               TTTTT               SSSSSSS       SSSSSSS
MMMMM                    MMMMM               TTTTT                 SSSSSSSSSSSSSSSSSS
MMMMM                    MMMMM               TTTTT                   SSSSSSSSSSSSS
MMMMM                    MMMMM               TTTTT                     SSSSSSSSS


                   SSSSSSSSSS  NN        NN HH        HH       444
                  SSSSSSSSSSSS NNN       NN HH        HH      4444
                  SS        SS NNNN      NN HH        HH     44 44
                  SS           NN NN     NN HH        HH    44  44
                  SSS          NN  NN    NN HH        HH   44   44
                   SSSSSSSSS   NN   NN   NN HHHHHHHHHHHH  44444444444
                    SSSSSSSSS  NN    NN  NN HHHHHHHHHHHH 444444444444
                           SSS NN     NN NN HH        HH        44
                            SS NN      NNNN HH        HH        44
                  SS        SS NN       NNN HH        HH        44
                  SSSSSSSSSSSS NN        NN HH        HH        44
                   SSSSSSSSSS  NN         N HH        HH        44
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1 12:1 O
2 12:1 O
3 3:2:1 [illegible]
4 Pd (4')
5 [illegible]
6 Ca
7 Ri (1:0)
8 Aj

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 I D A S
TATISTICAL RESEARCH LABORATORY
HE UNIVERSITY OF MICHIGAN
3:05:40
AY 11, 1983

READ FILE=METH-SCATTER(1001) VAR=1,#2,#3,4,5,6,7,#8,9,10,11,12,13,14,15,16 LABEL=NUMBER,OXY,CAT,DATE.M,DATE.D,DATE.Y,ODOM,TPRO,
LDY,MPG,HC,CO,COTWO,NOX,HC.NM,METHANOL CASES=1-999>

EAD OBSERVATIONS 1-999
ARIABLES BY CASE

MISSING VAR=ALL VALUES=-1>

ISSING DATA SUMMARY

  VARIABLE     #MISSING #LEVELS

  1.NUMBER
  2.OXY                   3
  3.CAT                  10
  4.DATE.M
  5.DATE.D
  6.DATE.Y
  7.ODOM
  8.TPRO                  7
  9.ALDY          137
 10.MPG            17
 11.HC
 12.CO
 13.COTWO          15
 14.NOX             6
 15.HC.NM          87
 16.METHANOL      273

UTAL MISSING      535
UTAL # CASES      437
```

```
<DESCRIBE BYSTRATA VAR=15 STRAT=V2*V3*V8>

DESCRIPTIVE MEASURES  <1> OXY:0*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .10420     .11590     .11005     .82731 -2

DESCRIPTIVE MEASURES  <2> OXY:3*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .10620     .12270     .11277     .87500 -2

DESCRIPTIVE MEASURES  <3> OXY:5*CAT:(#1)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           4  .10350     .1 150     .11892     .11721 -1

DESCRIPTIVE MEASURES  <4> OXY:0*CAT:(#2)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           1  .14440     .14440     .14440

DESCRIPTIVE MEASURES  <5> OXY:3*CAT:(#2)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .11530     .12990     .12380     .75901 -2

DESCRIPTIVE MEASURES  <6> OXY:5*CAT:(#2)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           1  .12620     .12620     .12620

DESCRIPTIVE MEASURES  <7> OXY:0*CAT:(#3)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .14240     .15490     .14865     .88388 -2

DESCRIPTIVE MEASURES  <8> OXY:3*CAT:(#3)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .15070     .15620     .15345     .38891 -2

DESCRIPTIVE MEASURES  <9> OXY:5*CAT:(#3)*TPRO:FTP

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV
  15.HC.NM              1  .19300      .19300       .19300

DESCRIPTIVE MEASURES   <10> OXY:0*CAT:(#4)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .14920      .15770       .15345     .60104 -2

DESCRIPTIVE MEASURES   <11> OXY:3*CAT:(#4)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .13400      .14680       .14040     .90510 -2

DESCRIPTIVE MEASURES   <12> OXY:5*CAT:(#4)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              3  .14530      .17010       .15453     .13559 -1

DESCRIPTIVE MEASURES   <13> OXY:0*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .26960      .27040       .27000     .56569 -3

DESCRIPTIVE MEASURES   <14> OXY:3*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .26680      .27440       .27060     .53740 -2

DESCRIPTIVE MEASURES   <15> OXY:5*CAT:(#5)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              3  .35200      .36400       .35940     .64715 -2

DESCRIPTIVE MEASURES   <16> OXY:0*CAT:(#6)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .89320      .89700       .89510     .26870 -2

DESCRIPTIVE MEASURES   <17> OXY:3*CAT:(#6)*TPRO:FTP

     VARIABLE           N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM              2  .87840      .91380       .89610     .25032 -1

DESCRIPTIVE MEASURES   <18> OXY:5*CAT:(#6)*TPRO:FTP
```

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     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .82560      .89770      .86165      .50982 -1

DESCRIPTIVE MEASURES  <19> OXY:0*CAT:(#7)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             3  .16210      .19340      .17787      .15651 -1

DESCRIPTIVE MEASURES  <20> OXY:3*CAT:(#7)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .14030      .15260      .14645      .86974 -2

DESCRIPTIVE MEASURES  <21> OXY:5*CAT:(#7)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .25110      .25110      .25110

DESCRIPTIVE MEASURES  <22> OXY:0*CAT:(#8)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             4  .43990      .60320      .53247      .67907 -1

DESCRIPTIVE MEASURES  <23> OXY:3*CAT:(#8)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .44500      .47130      .45815      .18597 -1

DESCRIPTIVE MEASURES  <24> OXY:5*CAT:(#8)*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .53460      .53460      .53460

DESCRIPTIVE MEASURES  <25> OXY:0*CAT:NONE*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM            10  .78040      1.0481      .90846      .88715 -1

DESCRIPTIVE MEASURES  <26> OXY:3*CAT:NONE*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             3  .78850      .85150      .81240      .33879 -1
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DESCRIPTIVE MEASURES  <27> UXY:5*CAT:NONE*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            2  .83150     1.1164      .97395      .20145

DESCRIPTIVE MEASURES  <28> UXY:0*CAT:STOCK*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            2  .13980     .14650      .14315      .47376 -2

DESCRIPTIVE MEASURES  <29> UXY:3*CAT:STOCK*TPRO:FTP

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            1  .13600     .13600      .13600

DESCRIPTIVE MEASURES  <31> UXY:0*CAT:(#1)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            3  .27000 -2  .38000 -2  .31667 -2  .56862 -3

DESCRIPTIVE MEASURES  <32> UXY:3*CAT:(#1)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            3  .59000 -2  .69000 -2  .65333 -2  .55076 -3

DESCRIPTIVE MEASURES  <33> UXY:5*CAT:(#1)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            4  .45000 -2  .80000 -2  .67250 -2  .13598 -2

DESCRIPTIVE MEASURES  <34> UXY:0*CAT:(#2)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            2  .45000 -2  .12500 -1  .85000 -2  .56569 -2

DESCRIPTIVE MEASURES  <35> UXY:3*CAT:(#2)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

   15.HC.NM            3  .72000 -2  .80000 -2  .75000 -2  .43589 -3

DESCRIPTIVE MEASURES  <36> UXY:5*CAT:(#2)*TPRO:HWY

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV
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  15.HC.NM            1  .83000 -2  .83000 -2  .83000 -2

DESCRIPTIVE MEASURES  <37> OXY:0*CAT:(#3)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .52000 -2  .79000 -2  .65500 -2  .19092 -2

DESCRIPTIVE MEASURES  <38> OXY:3*CAT:(#3)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            3  .60000 -2  .71000 -2  .65333 -2  .55076 -3

DESCRIPTIVE MEASURES  <39> OXY:5*CAT:(#3)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .60000 -2  .65000 -2  .62500 -2  .35355 -3

DESCRIPTIVE MEASURES  <40> OXY:0*CAT:(#4)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .52000 -2  .55000 -2  .53500 -2  .21213 -3

DESCRIPTIVE MEASURES  <41> OXY:3*CAT:(#4)*TPRO:MWY

     VARIABLF         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .47000 -2  .72000 -2  .59500 -2  .17678 -2

DESCRIPTIVE MEASURES  <42> OXY:5*CAT:(#4)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .57000 -2  .65000 -2  .61000 -2  .56569 -3

DESCRIPTIVE MEASURES  <43> OXY:0*CAT:(#5)*TPRO:MWY

     VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .11000 -1  .12000 -1  .11500 -1  .70711 -3

DESCRIPTIVE MEASURES  <44> OXY:3*CAT:(#5)*TPRO:MWY

     VARIABLF         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .92000 -2  .93000 -2  .92500 -2  .70711 -4

DESCRIPTIVE MEASURES  <45> OXY:5*CAT:(#5)*TPRO:MWY
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    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .89000 -2  .10000 -1  .94500 -2  .77782 -3

DESCRIPTIVE MEASURES   <46> UXY:0*CAT:(#6)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .25610     .34060     .29845      .59892 -1

DESCRIPTIVE MEASURES   <47> UXY:3*CAT:(#6)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .18910     .19940     .19425      .72832 -2

DESCRIPTIVE MEASURES   <48> UXY:5*CAT:(#6)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .12510     .16360     .14435      .27224 -1

DESCRIPTIVE MEASURES   <49> UXY:0*CAT:(#7)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             3  .60000 -2  .89000 -2  .71000 -2  .15716 -2

DESCRIPTIVE MEASURES   <50> UXY:3*CAT:(#7)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .52000 -2  .54000 -2  .53000 -2  .14142 -3

DESCRIPTIVE MEASURES   <51> UXY:5*CAT:(#7)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             1  .51000 -2  .51000 -2  .51000 -2

DESCRIPTIVE MEASURES   <52> UXY:0*CAT:(#8)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             3  .15900 -1  .22200 -1  .19200 -1  .31607 -2

DESCRIPTIVE MEASURES   <53> UXY:3*CAT:(#8)*THRU:HWY
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             4  .11800 -1  .17900 -1  .14300 -1  .29405 -2
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DESCRIPTIVE MEASURES  <54> OXY:5*CAT:(#8)*TPRO:HWY

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .16200 -1  .19300 -1  .17750 -1  .21920 -2

DESCRIPTIVE MEASURES  <55> OXY:0*CAT:NONE*TPRO:HWY

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM          10  .36130      .46260     .41892     .35065 -1

DESCRIPTIVE MEASURES  <56> OXY:3*CAT:NONE*TPRO:HWY

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .36180      .37980     .36843     .98896 -2

DESCRIPTIVE MEASURES  <57> OXY:5*CAT:NONE*TPRO:HWY

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .39000      .47150     .43075     .57629 -1

DESCRIPTIVE MEASURES  <58> OXY:0*CAT:STOCK*TPRO:HWY

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .70000 -3  .12000 -2  .90000 -3  .26456 -3
                                                .0009
DESCRIPTIVE MEASURES  <61> OXY:0*CAT:(#1)*TPRO:IDLE

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           2  .10000 -3  .29000 -2  .15000 -2  .19799 -2

DESCRIPTIVE MEASURES  <62> OXY:3*CAT:(#1)*TPRO:IDLE

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .15000 -2  .25400 -1  .94000 -2  .13439 -1

DESCRIPTIVE MEASURES  <63> OXY:5*CAT:(#1)*TPRO:IDLE

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM           3  .11000 -2  .12000 -2  .11667 -2  .57735 -4

DESCRIPTIVE MEASURES  <64> OXY:0*CAT:(#2)*TPRO:IDLE

    VARIABLE         N  MINIMUM    MAXIMUM      MEAN     STD DEV
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  15.HC.NM              2  .13000 -2  .24000 -2  .18500 -2  .77782 -3

DESCRIPTIVE MEASURES  <66> OXY:5*CAT:(#2)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              1  .30000 -2  .30000 -2  .30000 -2

DESCRIPTIVE MEASURES  <67> OXY:0*CAT:(#3)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              1  .41000 -2  .41000 -2  .41000 -2

DESCRIPTIVE MEASURES  <68> OXY:3*CAT:(#3)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              3  .51000 -2  .70800 -1  .31400 -1  .34754 -1

DESCRIPTIVE MEASURES  <69> OXY:5*CAT:(#3)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              0

DESCRIPTIVE MEASURES  <70> OXY:0*CAT:(#4)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              2  .17000 -2  .13000 -1  .73500 -2  .79903 -2

DESCRIPTIVE MEASURES  <71> OXY:3*CAT:(#4)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              2  .38000 -2  .66000 -2  .52000 -2  .19799 -2

DESCRIPTIVE MEASURES  <72> OXY:5*CAT:(#4)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              2  .86000 -2  .14900 -1  .11750 -1  .44548 -2

DESCRIPTIVE MEASURES  <73> OXY:0*CAT:(#5)*TPRO:IDLE

     VARIABLE           N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM              2  .79500 -1  .88900 -1  .84200 -1  .66468 -2

DESCRIPTIVE MEASURES  <74> OXY:3*CAT:(#5)*TPRO:IDLE
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    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .98200 -1  .12180      .11000      .16688 -1

DESCRIPTIVE MEASURES  <75> UXY:5*CAT:(#5)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .13180     .13530      .13355      .24749 -2

DESCRIPTIVE MEASURES  <76> UXY:0*CAT:(#6)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .14210     .14580      .14395      .26163 -2

DESCRIPTIVE MEASURES  <77> UXY:3*CAT:(#6)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .13910     .16040      .14975      .15061 -1

DESCRIPTIVE MEASURES  <78> UXY:5*CAT:(#6)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .15470     .16980      .16225      .10677 -1

DESCRIPTIVE MEASURES  <79> UXY:0*CAT:(#7)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             3  .50000 -3  .75000 -1  .33833 -1  .37863 -1

DESCRIPTIVE MEASURES  <80> UXY:3*CAT:(#7)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .63000 -2  .10900 -1  .86000 -2  .32527 -2

DESCRIPTIVE MEASURES  <81> UXY:5*CAT:(#7)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             1  .21900 -1  .21900 -1  .21900 -1

DESCRIPTIVE MEASURES  <82> UXY:0*CAT:(#8)*THRU:IDLE

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

 15.HC.NM             2  .40200 -1  .65500 -1  .52850 -1  .17890 -1
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DESCRIPTIVE MEASURES  <83> DAY:3*CAT:(#8)*TPRO:IDLE

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .52300 -1  .12410      .88200 -1  .50770 -1

DESCRIPTIVE MEASURES  <85> DAY:0*CAT:NONE*TPRO:IDLE

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             7  .61600 -1  .11220      .93057 -1  .12901 -1

DESCRIPTIVE MEASURES  <86> DAY:3*CAT:NONE*TPRO:IDLE

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .87100 -1  .87100 -1  .87100 -1

DESCRIPTIVE MEASURES  <87> DAY:5*CAT:NONE*TPRO:IDLE

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             0

DESCRIPTIVE MEASURES  <88> DAY:0*CAT:STOCK*TPRO:IDLE

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             4  .80000 -3  1.0000      .25155      .49897

DESCRIPTIVE MEASURES  <91> DAY:0*CAT:(#1)*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .20000 -2  .26000 -1  .14000 -1  .16971 -1

DESCRIPTIVE MEASURES  <92> DAY:3*CAT:(#1)*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             3  .90000 -2  .25000 -1  .15667 -1  .83267 -2

DESCRIPTIVE MEASURES  <93> DAY:5*CAT:(#1)*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

  15.HC.NM             3  .70000 -2  .12000 -1  .10333 -1  .28868 -2

DESCRIPTIVE MEASURES  <94> DAY:0*CAT:(#2)*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV
  15.MC.NM            2  .10000 -1  .11000 -1  .10500 -1  .70711 -3

DESCRIPTIVE MEASURES  <96> OXY:5*CAT:(#2)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            1  .14000 -1  .14000 -1  .14000 -1

DESCRIPTIVE MEASURES  <97> OXY:0*CAT:(#3)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            1  .30000 -1  .30000 -1  .30000 -1

DESCRIPTIVE MEASURES  <98> OXY:3*CAT:(#3)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            3  .13000 -1  .75000 -1  .37000 -1  .33287 -1

DESCRIPTIVE MEASURES  <99> OXY:5*CAT:(#3)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            0

DESCRIPTIVE MEASURES  <100> OXY:0*CAT:(#4)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            2  .20000 -1  .90000 -1  .55000 -1  .49497 -1

DESCRIPTIVE MEASURES  <101> OXY:3*CAT:(#4)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            2  .25000 -1  .27000 -1  .26000 -1  .14142 -2

DESCRIPTIVE MEASURES  <102> OXY:5*CAT:(#4)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            2  .18000 -1  .46000 -1  .32000 -1  .19799 -1

DESCRIPTIVE MEASURES  <103> OXY:0*CAT:(#5)*TPRO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN     STD DEV

  15.MC.NM            2  .24900      .29200       .27050      .30406 -1

DESCRIPTIVE MEASURES  <104> OXY:3*CAT:(#5)*TPRO:SS10
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    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .27100     .36200      .31650     .64347 -1

DESCRIPTIVE MEASURES  <105> UXY:5*CAT:(#5)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .51700     .53400      .52550     .12021 -1

DESCRIPTIVE MEASURES  <106> UXY:0*CAT:(#6)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .61500     .65600      .63550     .28991 -1

DESCRIPTIVE MEASURES  <107> UXY:3*CAT:(#6)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .53000     .56500      .54750     .24749 -1

DESCRIPTIVE MEASURES  <108> UXY:5*CAT:(#6)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .59300     .66500      .62900     .50912 -1

DESCRIPTIVE MEASURES  <109> UXY:0*CAT:(#7)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             3  .23000 -1  .24900      .15300     .11677

DESCRIPTIVE MEASURES  <110> UXY:3*CAT:(#7)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .58000 -1  .58000 -1  .58000 -1

DESCRIPTIVE MEASURES  <111> UXY:5*CAT:(#7)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             1  .96300 -1  .96300 -1  .96300 -1

DESCRIPTIVE MEASURES  <112> UXY:0*CAT:(#8)*TPHO:SS10

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.MC.NM             2  .18380     .28000      .23190     .68024 -1
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DESCRIPTIVE MEASURES  <113> OXY:3*CAT:(#8)*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             2  .21600      .53470     .37535     .22535

DESCRIPTIVE MEASURES  <115> OXY:0*CAT:NONE*TPRO:SS10

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             4  .38700      .59100     .45300     .93095 -1

DESCRIPTIVE MEASURES  <121> OXY:0*CAT:(#1)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             2  .40000 -2  .90000 -2  .65000 -2  .35355 -2

DESCRIPTIVE MEASURES  <122> OXY:3*CAT:(#1)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             3  .50000 -2  .34000 -1  .15000 -1  .16462 -1

DESCRIPTIVE MEASURES  <123> OXY:5*CAT:(#1)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             2  .40000 -2  .40000 -2  .40000 -2

DESCRIPTIVE MEASURES  <124> OXY:0*CAT:(#2)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             2  .50000 -2  .70000 -2  .60000 -2  .14142 -2

DESCRIPTIVE MEASURES  <126> OXY:5*CAT:(#2)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             1  .70000 -2  .70000 -2  .70000 -2

DESCRIPTIVE MEASURES  <127> OXY:0*CAT:(#3)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV

  15.HC.NM             1  .70000 -2  .70000 -2  .70000 -2

DESCRIPTIVE MEASURES  <128> OXY:3*CAT:(#3)*TPRO:SS20

     VARIABLE          N  MINIMUM    MAXIMUM      MEAN      STD DEV
```

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```
 15.HC.NM           3  .80000 -2  .23000 -1  .14333 -1  .77675 -2

DESCRIPTIVE MEASURES  <129> OXY:5*CAT:(#3)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           0

DESCRIPTIVE MEASURES  <130> OXY:0*CAT:(#4)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           1  .12800     .12800     .12800

DESCRIPTIVE MEASURES  <131> OXY:3*CAT:(#4)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           2  .34000 -1  .51000 -1  .42500 -1  .12021 -1

DESCRIPTIVE MEASURES  <132> OXY:5*CAT:(#4)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           1  .32000 -1  .32000 -1  .32000 -1

DESCRIPTIVE MEASURES  <133> OXY:0*CAT:(#5)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           1  .29200     .29200     .29200

DESCRIPTIVE MEASURES  <134> OXY:3*CAT:(#5)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           1  .42200     .42200     .42200

DESCRIPTIVE MEASURES  <135> OXY:5*CAT:(#5)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           2  .40400     .45500     .42950     .36062 -1

DESCRIPTIVE MEASURES  <136> OXY:0*CAT:(#6)*TPRO:SS20

    VARIABLE        N  MINIMUM    MAXIMUM      MEAN     STD DEV

 15.HC.NM           2  .53800     .59000     .56400     .36770 -1

DESCRIPTIVE MEASURES  <137> OXY:3*CAT:(#6)*TPRO:SS20
```

```
    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .49400      .53800      .51600      .31113 -1

DESCRIPTIVE MEASURES  <138> OXY:5*CAT:(#6)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .43900      .46500      .45200      .18385 -1

DESCRIPTIVE MEASURES  <139> OXY:0*CAT:(#7)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             3  .26000 -1  .16200      .81667 -.   .71276 -1

DESCRIPTIVE MEASURES  <140> OXY:3*CAT:(#7)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .70000 -1  .11200      .91000 -1  .29698 -1

DESCRIPTIVE MEASURES  <141> OXY:5*CAT:(#7)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             1  .12300      .12300      .12300

DESCRIPTIVE MEASURES  <142> OXY:0*CAT:(#8)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             2  .27970      .31900      .29935      .27789 -1

DESCRIPTIVE MEASURES  <143> OXY:3*CAT:(#8)*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             1  .19140      .19140      .19140

DESCRIPTIVE MEASURES  <145> OXY:0*CAT:NONE*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             7  .33800      .47200      .39114      .40433 -1

DESCRIPTIVE MEASURES  <146> OXY:3*CAT:NONE*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM       MEAN      STD DEV

 15.HC.NM             1  .33200      .33200      .33200
```

```
DESCRIPTIVE MEASURES  <147> OXY:5*CAT:NONE*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            0

DESCRIPTIVE MEASURES  <148> OXY:0*CAT:STOCK*TPRO:SS20

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            3  .10000 -2  .50000 -2  .23333 -2  .23094 -2

DESCRIPTIVE MEASURES  <151> OXY:0*CAT:(#1)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .10000 -2  .20000 -2  .15000 -2  .70711 -3

DESCRIPTIVE MEASURES  <152> OXY:3*CAT:(#1)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            3  .40000 -2  .60000 -2  .50000 -2  .10000 -2

DESCRIPTIVE MEASURES  <153> OXY:5*CAT:(#1)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .40000 -2  .50000 -2  .45000 -2  .70711 -3

DESCRIPTIVE MEASURES  <154> OXY:0*CAT:(#2)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            2  .40000 -2  .50000 -2  .45000 -2  .70711 -3

DESCRIPTIVE MEASURES  <156> OXY:5*CAT:(#2)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            1  .70000 -2  .70000 -2  .70000 -2

DESCRIPTIVE MEASURES  <157> OXY:0*CAT:(#3)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV

  15.HC.NM            1  .90000 -2  .90000 -2  .90000 -2

DESCRIPTIVE MEASURES  <158> OXY:3*CAT:(#3)*TPRO:SS30

    VARIABLE          N  MINIMUM    MAXIMUM      MEAN     STD DEV
  15.HC.NM           3  .14000 -1  .55000 -1  .32667 -1  .20744 -1

DESCRIPTIVE MEASURES  <159> OXY:5*CAT:(#3)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             0

DESCRIPTIVE MEASURES  <160> OXY:0*CAT:(#4)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .10000 -1  .10000 -1  .10000 -1

DESCRIPTIVE MEASURES  <161> OXY:3*CAT:(#4)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .60000 -2  .60000 -2  .60000 -2

DESCRIPTIVE MEASURES  <162> OXY:5*CAT:(#4)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .70000 -2  .70000 -2  .70000 -2

DESCRIPTIVE MEASURES  <163> OXY:0*CAT:(#5)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .63000 -1  .63000 -1  .63000 -1

DESCRIPTIVE MEASURES  <164> OXY:3*CAT:(#5)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             1  .13200      .13200      .13200

DESCRIPTIVE MEASURES  <165> OXY:5*CAT:(#5)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .24700      .25400      .25050      .49497 -2

DESCRIPTIVE MEASURES  <166> OXY:0*CAT:(#6)*TPRO:SS30

     VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM             2  .39000      .39700      .39350      .49497 -2

DESCRIPTIVE MEASURES  <167> OXY:3*CAT:(#6)*TPRO:SS30
```

```
    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            2  .40500      .40800       .40650      .21213 -2

DESCRIPTIVE MEASURES  <168> OXY:5*CAT:(#6)*THRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            2  .28500      .36800       .32650      .58690 -1

DESCRIPTIVE MEASURES  <169> OXY:0*CAT:(#7)*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            3  .40000 -2  .13000 -1  .80000 -2  .45826 -2

DESCRIPTIVE MEASURES  <170> OXY:3*CAT:(#7)*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            2  .40000 -2  .50000 -2  .45000 -2  .70711 -3

DESCRIPTIVE MEASURES  <171> OXY:5*CAT:(#7)*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            1  .50000 -2  .50000 -2  .50000 -2

DESCRIPTIVE MEASURES  <172> OXY:0*CAT:(#8)*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            2  .21700      .22870       .22285      .82731 -2

DESCRIPTIVE MEASURES  <173> OXY:3*CAT:(#8)*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            1  .12950      .12950       .12950

DESCRIPTIVE MEASURES  <175> OXY:0*CAT:NONE*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            7  .33400      .36400       .35086      .17421 -1

DESCRIPTIVE MEASURES  <176> OXY:3*CAT:NONE*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM        MEAN      STD DEV

  15.HC.NM            1  .32600      .32600       .32600
```

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```
DESCRIPTIVE MEASURES  <177> OXY:5*CAT:NONE*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            0

DESCRIPTIVE MEASURES  <178> OXY:0*CAT:STOCK*TPRO:SS30

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            4  .20000 -2  .50000 -2  .32500 -2  .15000 -2

DESCRIPTIVE MEASURES  <205> OXY:0*CAT:NONE*TPRO:SS40

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            2  .30800      .32800      .31800      .14142 -1

DESCRIPTIVE MEASURES  <206> OXY:3*CAT:NONE*TPRO:SS40

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            1  .28900      .28900      .28900

DESCRIPTIVE MEASURES  <207> OXY:5*CAT:NONE*TPRO:SS40

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            0

DESCRIPTIVE MEASURES  <208> OXY:0*CAT:STOCK*TPRO:SS40

    VARIABLE          N  MINIMUM     MAXIMUM       MEAN      STD DEV

  15.HC.NM            4  0.          .30000 -2  .17500 -2  .12583 -2
```

```
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NUMBER 690255        UNIVERSITY OF MICHIGAN TERMINAL SYSTEM  (MODEL AR173)         13:05:54 EDT      WED MAY 11/83


                                          USER: SNH4  PROJECT: SAMV

                                          OBTAINED AT 13:05:54  WED MAY 11/83
                                          RELEASED AT 13:06:00  WED MAY 11/83

                                          LINES PRINTED     594
                                          PAGES PRINTED      22


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3329----------------693329----------------693329----------------693329----------------693329----------------693329-------

HER 693329        UNIVERSITY OF MICHIGAN TERMINAL SYSTEM  (MODEL AR173)             11:58:44 EDT      THU MAY 12/83






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```
I D A S
ATISTICAL RESEARCH LABORATORY
E UNIVERSITY OF MICHIGAN
:58:21
Y 12, 1983

EAD FILE=-L(1001) VAR=1,#2,#3,4,5,6,7,#8,9,10,11,12,13,14,15,16 LABEL=NUMBER,OXY,CAT,DATE.M,DATE.D,DATE.Y,ODOM,TPRO,ALDY,MPG,HC,
,COTWO,NOX,HC.NM,METHANOL CASES=1-999>


AD OBSERVATIONS 1-999
RIABLES BY CASE


ISSING VAR=ALL VALUES=-1>


SSING DATA SUMMARY

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 2.OXY                 1
 3.CAT                 1
 4.DATE.M
 5.DATE.D
 6.DATE.Y
 7.ODOM
 8.TPRO                1
 9.ALDY
10.MPG
11.HC
12.CO
13.COTWO
14.NOX
15.HC.NM         2
16.METHANOL      2

TAL MISSING      4
TAL # CASES      2
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```
SCRIBE BYSTRATA VAR=9-12,14-16 STRAT=V2*V3*V8>
SCRIPTIVE MEASURES  <1> OXY:5*CAT:(#7)*IPRO:FTP
   VARIABLE         N  MINIMUM     MAXIMUM       MEAN     STD DEV
 9.ALDY             2  102.16      105.82      103.99      2.5880
10.MPG              2  13.638      13.770      13.704      .92985 -1
11.HC               2  .12881      .14000      .13440      .79125 -2
12.CO               2  .29930      .32630      .31280      .19092 -1
14.NOX              2  1.9065      1.9080      1.9072      .10607 -2
15.HC.NM            0
16.METHANOL         0
```

APPENDIX 6

Unscheduled Maintenance on the Vehicle

6-1

Appendix 6

Unscheduled Maintenance on the VW Rabbit

Date	Problem	Repair
Aug. 06, 1982	Fuel pump failure	Replaced with pump from local VW dealer
Aug. 10, 1982	Ran out of fuel	Refueled (no catalyst on the vehicle)
Aug. 18, 1982	None	New methanol-protected fuel pump installed
Oct. 26, 1982	Stalls shortly after cold start	Replaced thermal switch, distributor cap and rotor
Nov. 02, 1982	Fuel guage inoperative	Replaced sending unit (Nov. 8)
Nov. 04, 1982	None	Hooked up digital idle stabilizer, per VW instructions.
Nov. 08, 1982	Starter wouldn't disengage	2 relays interchanged by local dealer, old thermal switch installed
Nov. 10, 1982	None	New thermal switch reinstalled
Nov. 19, 1982	High thermocouple reading in catalyst (over 1600°F)	Inspect catalyst, recorder malfunction
Dec. 02, 1982	Emissions change (NOx)	Fuel pump from dealer reinstalled for diagnostic purposes
Dec. 07, 1982	Vacuum line to distributor found disconnected	Reconnected vacuum advance hose
Dec. 08, 1982	None	Methanol-protected fuel pump reinstalled
Feb. 07, 1983	NOx change	New O_2 sensor
Apr. 13, 1983	None	New battery installed

APPENDIX 7

Steady State Data at
0, 10, 20, and 30 Miles
per Hour

Summary of the Idle Test Results with Operation as 3-Way Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/min)	Fuel Min/gal	Number of Tests
		(g/min)							
None	0	.10	.09	.21	.74	.02	15.9	129	Up to 8
5 Pt: Rh (40)	0	.00	.--	.00	.03	.00	.1	120	4
12 Pt: Rh (40)	0	.00	.00	.01	.00	.00	.0	133	2
12 Pt: Rh (40)*	0	.00	.00	.01**	.00	.01	.9	140	2
3 Pt: 2 Pd (20)	0	.00	.00**	N/A	.00	.01	N/A	133	2
Pd (40)	0	.05	.--	.43**	.17	.01	8.7	120	3
Pd + BM (35)	0	.09	.08	N/A	.39	.02	13.3	136**	2
Cu	0	.15	.14	N/A	.58	.03	N/A	126	2
Pd (20)	0	.04	.03**	N/A	.14	.01	N/A	120	3
Ag (150)	0	.05	.05	N/A	.47	.02	N/A	128	2

N/A means data are not available

*Racetrack, others are round

**based on 1 test

Summary of the Idle Test Results with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes	Fuel $\frac{\text{Min}}{\text{gal}}$	Number of Tests
		(g/min)					(mg/min)		
None	3	.08	.09**	.23	.64	.01	18.2	138	up to 3
5 Pt: Rh (40)	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	3	.01	.01	.01	.06	.02	.3***	131	3
12 Pt: Rh (40)*	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
3 Pt: 2 Pd (20)	3	.03	.03	.03**	.11	.03	10.4**	117	3
Pd (40)	3	.01	.01	N/A	.00	.01	7.6	124	2
Pd + BM (35)	3	.11	.11	N/A	.43	.03	N/A	128**	2
Cu	3	.15	.15	N/A	.71	.03	N/A	120	2
Pd (20)	3	.01	.01	N/A	.01	.02	N/A	125	2
Ag (150)	3	.09	.09	N/A	.78	.02	N/A	113	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Idle Test Results
with Operation as Oxidizing Catalysts

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes	Fuel Min/gal	Number of Tests
		(g/min)					(mg/min)		
None	5	.10	N/A	.30	.75	.01	19.6	120	2
5 Pt: Rh (40)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.00	.00	.00***	.00	.01	1.0	122	3
12 Pt: Rh (40)*	5	.00	.00	.01	.01	.02	1.5	119	1
3 Pt: 2 Pd (20)	5	.05	N/A	N/A	.00	.02	53.0	116	2
Pd (40)	5	.01	.01	N/A	.01	.02	28.0	118	2
Pd + BM (35)	5	.14	.13	N/A	.62	.04	N/A	120	2
Cu	5	.16	.16	N/A	.62	.03	N/A	115	2
Pd (20)	5	.02	.02**	N/A	.00	.02	123.0**	121	2
Ag (150)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Test Data at 10 Miles per Hour with 3-Way Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol (g/mi)	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
	0	.48	.45	1.05**	3.08	.32	144.6	10.00	5
5 Pt: Rh (40)	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	0	.02	.01	.03	.00	.03	1.0	10.05	2
12 Pt: Rh (40)*	0	.02	.01	.16**	.00	.23	1.1	10.35	2
3 Pt: 2 Pd (20)	0	.03	.03**	N/A	.19	.04	N/A	10.00	2
Pd (40)	0	.10	.06***	.52**	2.89	.03	26.2	9.77	3
Pd + BM (35)	0	.28	.27	N/A	5.16	.29	75.7	10.30**	2
Cu	0	.65	.64	N/A	7.81	.31	N/A	10.10	2
Pd (20)	0	.17	.15	N/A	2.22	.03	N/A	10.10	3
Ag (150)	0	.24	.23	N/A	6.67	.30	N/A	10.05	2

N/A means data are not available

*Racetrack, others are round

**based on 1 test

***based on 2 tests

Summary of the Test Data at 10 Miles per Hour
with Oxidizing Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
				(g/mi)					
None	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
5 Pt: Rh (40)	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	3	.03	.02	.01	.03	.29	5.9	10.27	3
12 Pt: Rh (40)*	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
3 Pt: 2 Pd (20)	3	.05	.04	.04**	.07	.31	64.8**	9.70	3
Pd (40)	3	.04	.03	N/A	.02	.25	36.2	9.95	2
Pd + BM (35)	3	.33	.32	N/A	5.15	.30	N/A	10.10**	2
Cu	3	.56	.55	N/A	8.16	.30	N/A	10.05	2
Pd (20)	3	.07	.06	N/A	.03	.28	N/A	10.05	2
Ag (150)	3	.38	.38	N/A	9.43	.31	N/A	9.95	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Test Data at 10 Miles per Hour with Oxidizing Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
5 Pt: Rh (40)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.02	.01	.01***	.01	.31	3.8	9.93	3
12 Pt: Rh (40)*	5	.02	.01	.02	.02	.30	1.8	10.00	1
3 Pt: 2 Pd (20)	5	.55	N/A	N/A	.50	.26	294.8	9.80	2
Pd (40)	5	.05	.03	N/A	.01	.25	107.8	9.65	2
Pd + BM (35)	5	.54	.53	N/A	9.08	.34	N/A	10.00	2
Cu	5	.64	.63	N/A	8.15	.31	N/A	10.00	2
Pd (20)	5	.11	.10**	N/A	.04	.27	10.1**	10.00	3
Ag (150)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Test Data at 20 Miles per Hour with 3-Way Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	0	.40	.39	.98	4.77	.51	127.0	19.56	up to 8
5 Pt: Rh (40)	0	.01	.00****	.00	.05	.00	0.2	19.38	4
12 Pt: Rh (40)	0	.01	.01	.02	.02	.03	1.4	19.70	2
12 Pt: Rh (40)*	0	.01	.01	.04**	.00	.27	1.2	19.95	2
3 Pt: 2 Pd (20)	0	.02	.01	N/A	.53	.05	N/A	18.95	2
Pd (40)	0	.13	.13**	.32**	1.45	.04	20.3	18.00	2
Pd + BM (35)	0	.30	.29	N/A	3.10	.45	61.4	19.50	1
Cu	0	.57	.56	N/A	4.21	.51	N/A	19.00	2
Pd (20)	0	.09	.08	N/A	.85	.05	N/A	19.10	3
Ag (150)	0	.30	.30	N/A	3.41	.43	N/A	18.95	2

N/A means data are not available

*Racetrack, others are round

**based on 1 test

***based on 3 tests

one	3	.34	.33						
5 Pt: Rh (40)	3	N/A	N/A	N/A	N/A	N/A			
12 Pt: Rh (40)	3	.02	.02	.02	.09	.48	1.8***	19.57	3
12 Pt: Rh (40)*	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
3 Pt: 2 Pd (20)	3	.02	.01	.05***	.00	.48	70.6**	18.80	3
Pd (40)	3	.05	.04	N/A	.01	.42	102.6	18.70	2
Pd + BM (35)	3	.43	.42	N/A	4.17	.53	N/A	18.90	1
Cu	3	.52	.52	N/A	4.06	.51	N/A	18.95	2
Pd (20)	3	.10	.09	N/A	.04	.37	N/A	19.15	2
Ag (150)	3	.25	.19**	N/A	4.26	.33	N/A	19.10	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Test Data at 20 Miles per Hour with Oxidizing Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	5	.34	N/A	1.19	4.37	.43	105.0	19.00	up to 2
5 Pt: Rh (40)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.01	.00	.00**	.00	.47	1.4	19.40	2
12 Pt: Rh (40)*	5	.01	.01	.10	.01	.47	1.5	19.40	1
3 Pt: 2 Pd (20)	5	.14	N/A	N/A	.16	.40	155.2	18.40	2
Pd (40)	5	.04	.03	N/A	.02	.37	138.9	18.60	1
Pd + BM (35)	5	.44	.43	N/A	4.30	.43	N/A	19.05	2
Cu	5	.46	.45	N/A	3.74	.45	N/A	19.25	2
Pd (20)	5	.09	.12**	N/A	.01	.41	N/A	19.30	3
Ag (150)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

N/A means data are not available

*Racetrack, others are round

**based on 1 test

Summary of the Data at
30 Miles per Hour with 3-Way
Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	0	.36	.35	0.83	4.85	1.21	126.8	20.90	Up to 8
5 Pt: Rh (40)	0	.01	.00	.01	.06	.00	1.8	21.35	4
12 Pt: Rh (40)	0	.00	.00	.00	.02	.00	0.4	21.55	2
12 Pt: Rh (40)*	0	.01	.00	.02**	.01	.48	3.6	21.35	2
3 Pt: 2 Pd (20)	0	.01	.01**	N/A	.22	.04	N/A	20.60	2
Pd (40)	0	.01	.01**	.04**	.55	.01	3.5	20.30	2
Pd + BM (35)	0	.07	.06	N/A	2.20	1.11	38.0	21.50	1
Cu	0	.40	.39	N/A	5.05	1.12	N/A	21.05	2
Pd (20)	0	.01	.01	N/A	1.13	.02	N/A	20.80	3
Ag (150)	0	.23	.22	N/A	4.09	1.04	N/A	21.40	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Data at 30 Miles per Hour with Oxidizing Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
		(g/mi)							
None	3	.33	.33**	.89	4.20	1.20	129.1	21.30	3
5 Pt: Rh (40)	3	N.A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	3	.01	.00	.00	.00	1.19	2.2	21.43	3
12 Pt: Rh (40)*	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
3 Pt: 2 Pd (20)	3	.04	.03	.10***	.01	1.23	70.7**	19.88	3
Pd (40)	3	.01	.01***	N/A	.01	1.05	18.2	20.55	2
Pd + BM (35)	3	.14	.13	N/A	3.98	1.07	N/A	21.20	1
Cu	3	.41	.41	N/A	4.69	1.11	N/A	20.90	2
Pd (20)	3	.01	.00	N/A	.00	1.02	N/A	21.20	2
Ag (150)	3	.13	.13**	N/A	4.64	.94	N/A	21.95	2

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests

Summary of the Data at
30 Miles per Hour with
Oxidizing Catalyst Operation

Catalyst	Oxygen Level (%)	HC	NMHC	Methanol	CO	NOx	Aldehydes (mg/mi)	MPG	Number of Tests
				(g/mi)					
None	5	.32	N/A	.91	4.39	1.18	115.3	21.13	3
5 Pt: Rh (40)	5	N.A	N/A	N/A	N/A	N/A	N/A	N/A	0
12 Pt: Rh (40)	5	.01	.00	.00**	.00	1.22	1.4	21.30	2
12 Pt: Rh (40)*	5	.01	.01	.05	.03	1.22	5.6	20.30	1
3 Pt: 2 Pd (20)	5	.06	N/A	N/A	.06	1.16	107.0	20.20	2
Pd (40)	5	.01	.01	N/A	.01	1.07	22.9	20.70	1
Pd + BM (35)	5	.26	.25	N/A	4.52	1.08	N/A	21.20	2
Cu	5	.33	.33	N/A	3.91	0.96	N/A	20.90	2
Pd (20)	5	.01	.00**	N/A	.01	1.07	N/A	21.17	3
Ag (150)	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

N/A means data are not available
*Racetrack, others are round
**based on 1 test
***based on 2 tests